amateur 73 radio

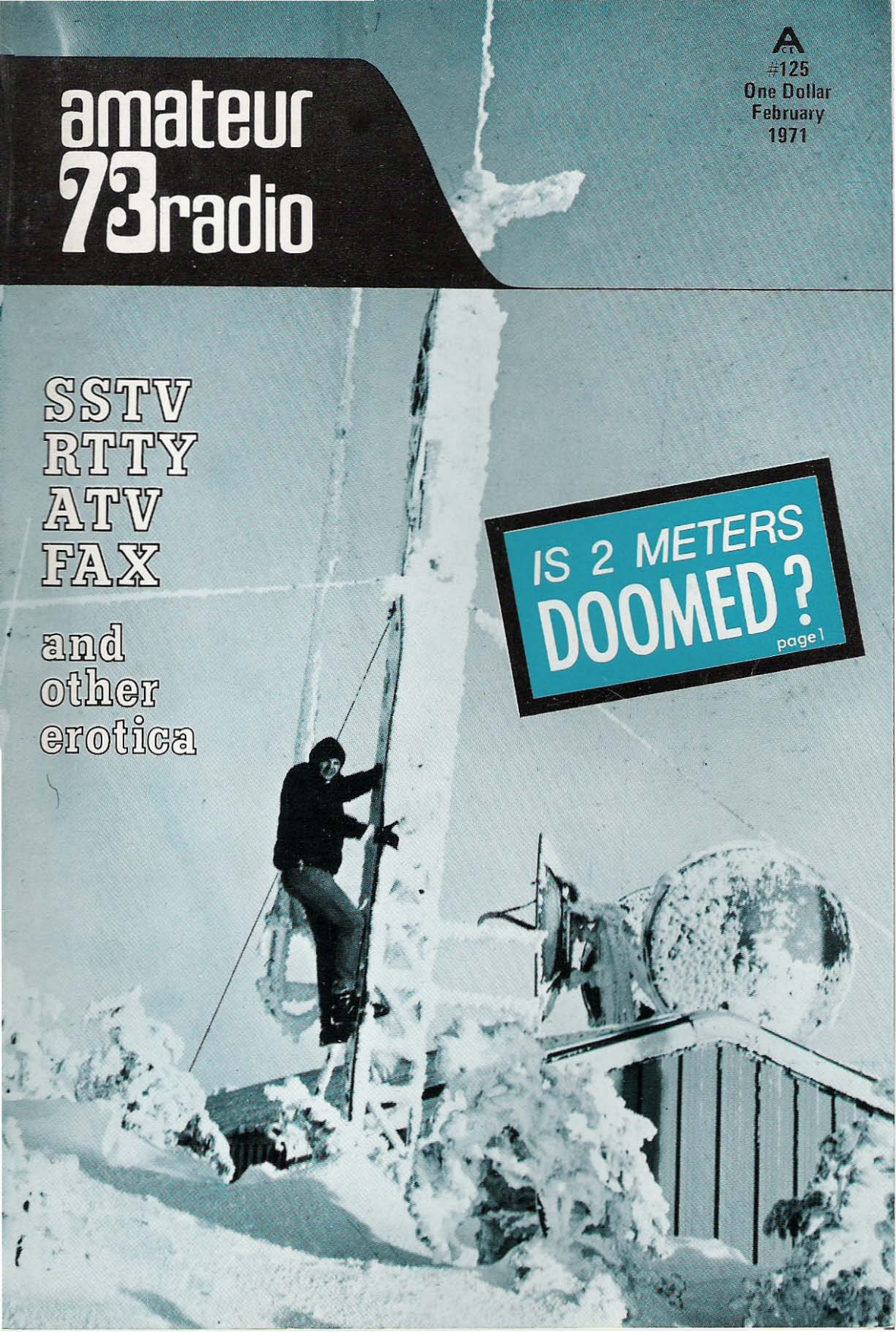
#125
One Dollar
February
1971

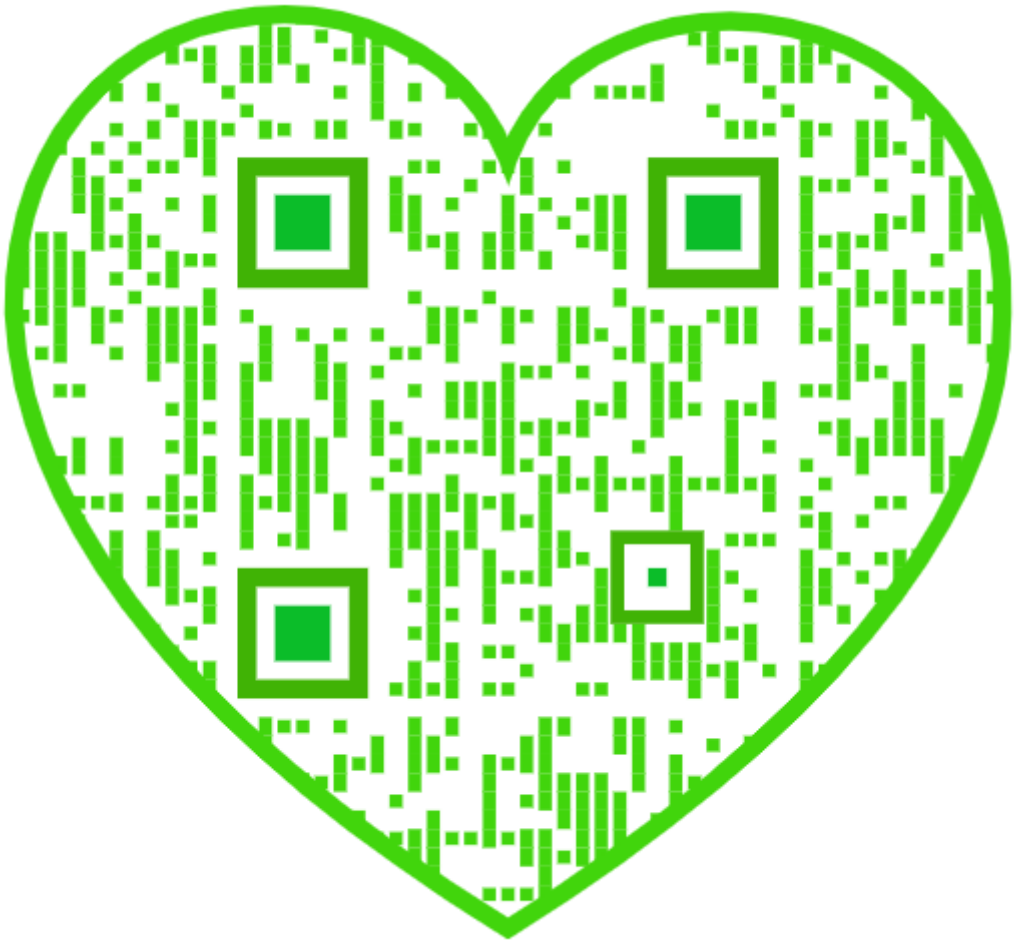
SSTV
RTTY
ATV
FAX

and
other
erotica

IS 2 METERS DOOMED?

page 1





Issue 125 **Amateur Radio 73** February 1971

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NEVER SAY DIE

The most serious attempt ever mounted against the 2 meter band recently took place.

Industry insiders intimate that this scheme was cooked up by the publisher of S9 (also publishes CQ) magazine. Since this was virtually admitted in a recent CQ editorial there seems little reason to doubt the reports.

S9, which has proposed such gems as sending empty beer cans to senators to impress them with the importance of CB, apparently has been feeling a need for more circulation and promoted the idea of throwing the amateurs out of half of the 2 meter band and turning it over exclusively to the CB gang. More manufacturers than you might think went along with this plan and it was backed by the most powerful CB industry group in the country.

This was not a plan for developing more amateurs, but purely and simply a scheme for selling more CB sets and more CB subscriptions.

The 2 meter band was opened in early 1946, just after the end of World War II, when the old 2½ meter band was taken away. 2½ meters was the first amateur band returned after the war, but the many radar (SD radar) and other units using the band during wartime were still around and the amateur band had to be moved up to 144MHz from 112 MHz.

By late 1946 this band was in heavy use with simple modulated oscillators and superregenerative receivers. As more and more military surplus was released, crystal control became the order of the day. By the early 1950s SCR-522s, ARC-1s, and several other surplus sets were just about everywhere. It wasn't long before Galaxy had started turning out a nice little FM unit and two or three others were being imported from Japan. By 1970 this turned to a rush, as virtually every ham equipment manufacturer entered the FM market. None of these companies were doing this for fun – all this gear was being produced because amateurs were turning to 2m FM by the thousands.

Much has been written about this totally new type of ham operation, so that won't be rehashed here. The development of FM nets, the erection of hundreds of repeaters, and the fascination of this new type of operation started the biggest move to a new mode since the sideband revolution in the mid-50s.

Virtually all of this FM activity is taking place in the 146–147 MHz segment of the 2m band. Though there are perhaps 20,000 active FM'ers in this band at present, there is still plenty of room for five times that number . . . or more . . . before crowding may become a serious problem. Oh, there are many problems due to too many repeaters being on one channel or too few being tone operated, but only a few of the many channels in this segment of the band have been used in any area and lots more wait unused.

When one considers the extent of the disaster that might come about if this band were taken away from the amateurs and turned over to CB, one wonders what possibly could have been going through the minds that cooked up the plan to do away with a good part of 2m. The expansion of FM on 2m may well be one of the best things that has ever happened to amateur radio. The emergency uses of this service are almost unlimited and could well do away with lower frequency nets. Think of the CD possibilities when low-powered hand transceivers can, through repeaters, be used just about anywhere. They can talk with each other through the repeaters, or be relayed on lower bands to anywhere in the world.

The systems being developed on 2m today will probably be used when amateur satellites and moon relay stations are an ordinary fact of life.

Fortunately, news of the attempt to emasculate 2 meters leaked out at the last minute and, hopefully, the effort was stopped – at least temporarily.

The proposal for the 220 MHz hobby class amateur license took a lot of the steam out of the push to take away 2 meters. Indeed, this may have been the deciding factor that kept the 2 meter proposal from being made.

Write to the publisher of S9 and CQ and tell him what you think of the plan to chop up two meters. Do what you can to stop this once and for all. Silence on your part means that you either agree that two should be given away or that you don't care.

THE WORLD OF FM

Editorial by **Ken Sessions K6MVH**

Repeater Proposal RM-1725

The FCC now has before it a petition for repeater rulemaking that should go a long way toward pleasing everyone. When one repeater group proposed mandatory tones a long time back, lots of other repeater groups screamed bloody murder – they didn't want to be tied down to restrictions that clearly weren't necessary in their rural areas. When another repeater group, even earlier, proposed that automatic relay stations be allowed to operate without a continuous monitor on the UHF control frequency, the ting. That's life.

One very effective method for separating the sheep from the goats is through the use of access tones. Now, a repeater user must transmit a specific tone before the repeater will respond to his transmissions. And if gibberish starts coming through the repeater – or foul language, or interference, or general abuse – the transmitting station will have no out. He can no longer claim innocence because *he had to transmit that initial tone that would cause him to be repeated.*

Clearly, the responsibility for a re-

.34/.94 as well as other combinations, why not just expand? If there is already a repeater within your range that's using the .34 frequency as an input, forget it! Be the first in your area to use .16/.76.

There's a great deal to be said for .16/.76. Not only is it a standard frequency pair separated by the standard 600 kHz spacing, but it allows the repeater users to get a little something extra when they crystal up their transceivers. They'll already have .94 direct and .34/.94 if they've bought one of the more popular of the new units

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73 Magazine is published monthly by 73 Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas, $7 per year elsewhere. Two years $10 in U.S. and $12 overseas. Three years $14, and $16 overseas. Second class postage paid at Peterborough, N.H. and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A.

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where. Then came the day of the Gonset Communicator... the Goony Boxes... they were everywhere, by the thousands. Never had a piece of ham gear been as popular as this little transceiver. By the mid-50s there were over 10,000 active 2 meter ops!

The opening of the band to the Technician and Novice licensees did in no way slow down the activity on 2 meters. But the opening of 6 meters did. The techs rushed to 6 meters almost *en masse* and, armed with Heathkit Lunchboxes, 6 meter Goony Boxes, and a sprinkling of Clegg gear, they proliferated. And 2m began to fade away.

Gonset brought out the Sidewinder for 2 meters... it fell on its face. Never more than a handful of pioneers made the sideband scene on two. The incompatibility of the SSB gear with communicators further disrupted the band, giving both groups fewer people to contact.

Up above 146 MHz there was something beginning to grow... FM. At first there were a few hardy ops that set up shop, and found only a few others to talk with. The AM and SSB groups couldn't break in and talk with the FM boys, so they kept up their life in the lower part of the band and ignored the FM'ers.

Next, the FCC shoved the Novices off 2 meter phone and the 145–146 MHz segment of the band really became deserted much of the time. The seasoned oldtimers still chatted down along the low end of the band, but they never listened for the Techs or Novices anyway. This was true in most of the country, with the southern California area probably being the only real exception.

At this time great quantities of commercial wideband FM gear became available which tuned to 2 meters. The rush to FM was on in earnest. Rule changes for the commercial services obsoleted thousands of units and they swiftly fell into amateur hands at a fraction of their commercial prices.

That brings us up to about 1968. As the commercial gear supply dried up and used gear began to disappear from the surplus ads in the ham magazines, manufacturers and importers began to take a closer look at the ham market. FCC winced. They weren't about to turn a bunch of unmonitored stations loose on the ham bands – such a method of operation was unprecedented in the amateur service for one thing; and for another, who would be held responsible when things weren't going according to the book?

This new petition, officially labeled RM-1725, could be the first step toward sensible legislation involving repeaters. In essence, the proposed rule says that those who use repeaters should be responsible for what goes out on the repeater transmit frequency – provided that those users have a means for commanding the repeater to be actuated (as with tone access).

Put differently, toned repeaters would not be required to be monitored by a fixed-control-point licensee who mans the UHF control rig. Repeaters that remain carrier-operated would still be required to have a continuous UHF control licensee monitoring at all times the repeater is in use.

Basis for Reasoning. At first glance, the petition might sound prejudicial to toned repeaters. But this ain't the case at all. Here's why: Take the case of a purely carrier-operated repeater, for example. Any station that happens across the repeater input frequency – whether he be AM, CW, TV, RTTY, or what-have-you – gets repeated. If the station is not FM, all that comes out of the repeater is garbage. Who should be responsible for tying a chunk of spectrum up for long periods and dominating an otherwise useful repeater channel... the repeater owner? Or the fellow who's transmitting the teletype on the input frequency? It's something of a moot question. If the fellow transmitting the teletype claims innocence in that he was transmitting without knowledge of the fact that he was being repeated, what could you say? And if the interfering station's transmissions weren't legal for any reason, should the repeater owner be held accountable? Remember, if the input station is making illegal transmissions, the repeater is making illegal transmissions. If someone uses your station to transmit dirty words, your station is liable to the same extent that the amateur is who does the transmitpeater's output can logically be placed where it belongs – in the hands of the users. But to carry out an *overall* sense of responsibility, the repeater should be designed with sufficient safety features to show the FCC that when things begin to go awry, the users themselves can initiate commands that cause the repeater to shut down. A timer on the transmitter B-plus relay, for example, should shut down the repeater when a transmission exceeds 3 minutes. Then, if the carrier-operated relay gets stuck down (intentionally or on purpose), or if something goes wrong with the repeater control circuitry, the whole system will turn itself off automatically. A user noticing an illegal transmission need but transmit a continuous signal for 3 minutes to shut things off.

A 5-second timer connected to the repeater's tone decoder could likewise cause shutdown in the event that the repeater's output deviates from the rules. Thus, any of the tone-equipped user stations could assert temporary but effective control over the repeater until the prime licensee could be notified and repairs begun.

You can't make much of a case for no-monitor operation of untoned repeaters, though. Someone *has* to be responsible for what's happening. And if the station being repeated can beg ignorance of the existence of a repeater, how could he logically be held accountable for what happens on its output?

So RM-1725 is a proposal that says toned repeaters need not be monitored and that simple carrier-operated systems *should* be. The proposal seems very sound to me. And well it should, since I am the one who initiated the proposal in the first place.

Coordination of Repeater Frequencies

Part of the source of problems in a number of portions of the country stems from the overeager clambering for a repeater that operates on the .34/.94 pair. It's nice to have repeaters on .34/.94, because you can travel here and there and be assured of some degree of standardization. But today .34/.94 is overpopulated. And, since most modern transceivers come equipped with enough channels to give you available to the amateur. When they add the .16/.76 pair, they'll also have the capability of crosswiring the .34 transmit crystal and the .76 receive crystal to a fourth position on the frequency switch so they can work through any of the many southeast and upper midwest machines that use the .34/.76 combination. At least give it some thought.

I am in a pretty fair position here at 73 to be of considerable help if your group or any other needs advice with respect to frequency coordination. Inasmuch as 73 publishes a periodic repeater directory, I am one of the first to be informed of new repeaters going up. So if you want to install a repeater, why not check with me to see what other frequencies are in use in your area; chances are I'll have accurate and up-to-date information. You're under no obligation to follow my suggestions, of course, but I can steer you clear of frequencies that might interfere with repeaters that are already under way. And if there is a trend toward a certain pair of frequencies in your area of the country, I can let you know those trends so you can make your repeater compatible with those. Such compatibility does enhance the usefulness of repeaters.

When you let me know of your intent to put up a repeater, I can mail you a list of the repeaters that are within a couple of hundred miles of you. And if you don't like the pair of frequencies I pick for you, you would at least be in a position to choose your own based on what's happening on the spectrum in question.

Things to Come

I'm no prophet, but I'll bet I can predict the future of certain aspects of the VHF FM world. Look for CQ to claim it is responsible for getting amateur FM started big. Look for the ARRL to put up an official *League Repeater*. Look for lots and lots of FM articles in all the ham magazines from now on. And look for an onslaught of new FM transceivers at better and better prices. Look for the ex-publisher of FM to make another try. And look for new names in the field of manufacturing of equipment designed to complement existing FM stations.

HAM USES REPEATER FOR THREATS, PROFANITY

LOSES OPERATOR PRIVILEGES

By an FCC order, Armond J. Rolle was directed to show cause why the license for radio station W9FCE should not be revoked for misconduct on the air. The order called upon the licensee to appear and give evidence in respect thereto at a hearing. By a second order, Rolle's amateur Technician class operator license was suspended for the balance of the license term pursuant to the Communications Act of 1934, subject to his right to request a hearing on the matter. Rolle did request the hearing, which was held in East St. Louis, Illinois, on September 15, 1970, on which date the record was closed.

Each of the said orders recites that Armond J. Rolle was charged with and convicted of criminal defamation for having communicated (by amateur radio) certain statements which concerned the character of a named person and by making threats of personal harm so as to provoke a breach of the peace; and that at various times since then transmitted communications of a threatening, abusive, and indecent nature.

The proposed station license revocation was based on rectials stating that the Commission would be warranted in refusing a grant of a license were the original application now before it and that the actions described are contrary to the public interest, convenience, and necessity standards of Sections 301 and 307(a) of the Act. The operator's license revocation was based on a recital that the actions described were contrary to the public interest, convenience, and necessity. Rolle's license was therefore suspended.

Evidence

The Bureau presented authenticated documents relating to respondent's conviction on criminal charges and a transcript of taped transmissions by respondent. Rolle testified in his own behalf, denying the authenticity of the statements attributed to him, but at the conclusion of which his counsel made a conciliatory statement. Rolle himself suggested a suspension of his operator's license until November 1, 1971, but without revocation of the station license.

One La Busier, an amateur licensee and holder of a technician class amateur license threatening language over the air. Rolle had been unable to use the repeater station of the St. Louis Repeater Club on occasions because people told him to get off the air; he had been "cussed at"; had music played; and otherwise harassed. He once reported such violations to the FCC; a field representative came to St. Louis in March 1969 and talked to him about it, but so far as he knows, nothing was done about it.

Rolle wrote the apologetic letter to La Busier when he had a serious operation and was under sedation and immobilized for 10 days. His purpose was to apologize for having called La Busier a "dirty rat" when the latter "interfered with" and "jammed" a transmission he was making. He said he had no intent to harm anyone and did not refer to Mrs. La Busier in the terms indicated in the tape transcript. He was "drinking badly" due to intense pain in his legs for which the operation was later performed, but he "does not drink now, due to ulcers." His criminal conviction for alleged acts on a day when his transmitter was being repaired, according to Rolle, came about because when he testified in court in his own behalf he was under heavy sedation and his counsel would not let him bring out the "whole details."

Rolle specifically acknowledged portions of the transcript while disclaiming others. He "guessed" however, that anyone in a "drunk" might do things he can't later recall and he could not swear that he could not have said these things while drunk. He also accused other amateurs of using his call signal because he overheard discussions of splicing and splitting tapes, but did not know who was impersonating him. He also alleged there was a "personal grudge" between himself, La Busier, and one other named amateur. He acknowledged the conversation with his aunt, Mrs. Stolle, but denied some of the specific statements.

Rolle himself maintained continuous tape surveillance of the assigned band but lost the tapes when his barn burned. While he has station logs for the period in question, he did not produce them.

Finally, the record disclosed he was indulging in "heavy sedation and alcohol" during the "abuse" period. Respondent's proposed findings also allege that his conduct has been above reproach since then, but this is contrary to the record, there having been two instances of defamatory remarks subsequent to that date. Rolle proposed a one-year suspension of his operator's license, and that the station license not be revoked.

Despite an apparent conclusive record, there being no dispute as to the facts, and the inexcusable and reprehensible nature of respondent's transgressions, there remained a troublesome question for disposition. The Bureau inexplicably relied solely on the broad standards of Sections 301 and 307(a) of the Act and completely ignored the provisions of Sections 303 and 312 which spell out the specific reasons for revocation or suspensions and the manner in which accomplished. The only conclusion offered by the Bureau related to those sections, is the statement which, though not so identified, is found in Section 312(a)(2):

"Also, as charged, it is concluded that these actions would warrant the Commission in refusing to grant an application filed by Respondent for an Amateur radio license if the original application were now before it."

The Bureau offered nothing, however, to relate Rolle's actions to statute, regulation, or Commission precedent, to sustain its conclusion. Section 301 provides for the licensing of radio channels but contains no reference to public interest or other standard; Section 307(a) provides for the grant of station licenses "if public convenience, interest, or necessity will be served thereby." This, of course, is a standard *for granting rather than for revoking* or denying.

The Bureau concluded that the Commission would be warranted in refusing to grant an application filed by Rolle if the original application were now before it, and, if so, this would justify the proposed action under Section 312(a)(2). But the Bureau makes this as a mere assertion without citation to statute, regulation, or precedent. While Section 308(b) authorizes the Commission to prescribe qualifications as to "citizenship,

HAM RADIO FOR CRIME NOT ILLEGAL

FCC Examiner Finds Loophole In Regs

FCC Hearing Examiner Fred Denniston, in reviewing a case before the Commission, came to the shocking conclusion that it is not unlawful to use ham radio for criminal purposes. "There is no direct prohibition," he said, "against the use of amateur radio for criminal purposes."

His finding noted that the CB regulations (Part 95 of the Commission's Rules) prohibits use "for any purpose, or in connection with any activity, which is contrary to Federal, State, or local law."

The flaw in the ham portion of the rules was noted while Examiner Denniston was reviewing the suspension order of Armond Rolle, an amateur who allegedly committed criminal acts on the air.

NO-MONITOR REPEATER OPERATION PROPOSED

Washington, D.C.s, The FCC is now considering a proposal to suspend monitoring requirements for repeaters that are tone controlled from the frequency of actual operation. The existing Rules require the licensed control amateur operator to monitor *from the fixed control point* at all times the repeater is in use (or available for use). The new proposed rule (RM-1725) would shift the responsibility to the stations who actually use the repeater.

Fixed-control-point monitoring has been the traditional requirement so that the repeater's operation could be suspended at any time its emissions deviated from the amateur rules of Part 97. Without tone control, there is no assurance that a repeater user is using the repeater intentionally; thus, if the emissions were not as required, there might be no means of shutting down the repeater unless the licensed control amateur is monitoring actively.

With tone control, however, the repeater can only be used when the user station

U.S. FAVORS BAN ON IMPORTS IF EXPORT NATIONS BAR U.S.

Newsweek Survey Shows One-Third Believe Quality of American Goods Declined Over Decade, But U.S. Products Still Get Highest Confidence

New York More than four Americans in five favor keeping foreign-made goods out of the U.S. if overseas nations bar the importation of American products. And three out of four believe the American public should buy "made in U.S." products because the increased buying of imports is causing unemployment. These are some of the findings of a survey of consumer attitudes released today by the marketing department of Newsweek magazine.

The survey, "Public Attitudes Toward Imported Products in the U.S. Market," was conducted for Newsweek by National Family Opinion, Inc. The study shows that despite their strong, outwardly protectionist views, the overwhelming majority of Americans still support the principles of a free market system. Two-thirds of the national sample – and three-fourths of a special high-income segment – agree that people *should buy products of the highest quality at the lower price no matter where they are made.*

In reviewing the findings, Newsweek Marketing Director Andrew Cullen noted that in designing the study, the trend of protectionist feeling among Americans was anticipated and, therefore, questions on the subject were included in the questionnaire. "They reflect no advocacy by Newsweek but rather are an attempt, at the request of a number of manufacturers and their advertising agencies, to assay the dimensions of this feeling," he said.

The sample in the poll consisted of 3,000 panel families which included an over sample of 500 families with annual income of $15,000 or more. Response rate from the combined samples was 75.6%. The purpose of the oversample was to determine if high-income families have attitudes toward imported products that differ from the population as a whole.

In the area of product quality, the Newsweek study shows that of four major industrial nations mentioned – three foreign

for about 10 years, has known Rolle for about the same length of time and has exchanged communications with him. At times, these communications were normal, but at others Rolle was transmitting foul and obscene statements concerning La Busier, his wife and child, other amateurs, and threats to people. Accordingly, La Busier made tape recordings, talked to law enforcement officers, and filed the criminal charges on which Rolle was convicted. La Busier also introduced a handwritten letter, dated October 29, 1969, which he had received from Rolle. The letter, written in advance of a serious operation which he was about to undergo, may generally be described as a confession of improper conduct toward La Busier and other ham operators, and a request for forgiveness.

Mrs. La Busier, also an amateur, identified various portions of the transcript of which she had made the taping, or had personally heard at the time, identifying the voice of W9FCE as that of Rolle's. Mrs. La Busier was the subject of the defamatory remarks which led to Rolle's conviction, and on other occasions as well, including threats of bodily harm. The provocative nature of these remarks is indicated by the transcript of December 16, 1968, when Mrs. La Busier, in retaliation, threatened to "blow that beady little head of yours (Rolle's) right off your shoulders."

Mrs. Stolle, an aunt of Rolle's identified a portion of the transcript where she remonstrated with Rolle on December 16, 1968, in a transmission from the La Busier station, for statements he had been making and in which he described himself as "dead drunk." She further confirmed threats which Rolle had made to "get" or "do harm" to La Busier, his family, and others if he should have his license revoked – specifically that he would bomb their houses.

Mrs. Familton, another amateur, described a number of transmissions by Rolle, whose voice she recognized, of the same nature as those in the FCC exhibit, and independently verified several of the instances in that transcript, including threats against the lives of herself and other members of the St. Louis Repeater Club. She also described an instance in March 1970, when she personally met Rolle and he apologized for the things he had said, explaining that he had been under a considerable strain and not feeling well. She also described an instance before Rolle's conviction in December 1969, when, after she had made a test call, Rolle came on and characterized her as a "fat old whore." Again, while her family was on an automobile trip during which her four children became boisterous, her husband made a transmission from their mobile unit, at the conclusion of which Rolle came on and characterized the children as a "bunch of bastards." The St. Louis Repeater Club, of which she is secretary, had expelled Rolle from membership because of his conduct on the air.

Rolle's Defense

Rolle, testifying in his own behalf, categorically denied making any such transmissions, or that he had ever used obscene or

Findings of Fact

Rolle, using station W9FCE, did make the transmissions which served as the basis of the show cause order. The statements include transmissions which Rolle himself conceded to be obscene; much profanity, defamatory statements of the nature on which he was prosecuted; and threatening statements of the following nature:

"... I said I woulda run into both cars today when you were at that house only thing I didn't want to hurt Harold Weiss. Luckily, he was standing there or I woulda hurt a whole bunch of other people. That was my intention."

"... She see me on the street, I don't run cause I carry a .25 automatic on me at all times. And I know how to use it. ..."

"Stupid, got something to tell you. You're gonna have an accident between Godrey and MacDonald coming home some evening here – some way, somehow. But you're gonna have an accident and it's gonna be fatal."

"... I ever see any of youse in person, I'm gonna blow your damn heads off. ..."

"... You people ain't fit to live, and by golly, you won't much longer."

These statements (all from FCC staff Exhibit 2) are against a background of Mr. Rolle's formidable appearance, which is described in the record as "unusually large in height and weight." Rolle is described as being 6 ft 11 in. tall and weighing in excess of 400 pounds, which is compatible with the observations of the hearing examiner.

Conclusions

The Bureau concluded that respondent's actions are not consistent with the purposes for which amateur radio is intended and are clearly, as charged, contrary to the public interest, convenience, and necessity. Also, as charged, it was concluded that these actions would warrant the Commission in refusing to grant an application filed by respondent for an amateur radio license. With respect to respondent's plea for clemency, the Bureau contended that due to the complete lack of candor exhibited through denial and subsequent admission of the matters charged, the defense of effects of drugs and alcohol is not a mitigation of the offense. Pointing to the heinous nature of the transmissions, the Bureau urged the imposition of the most severe sanctions available – revocation of the station license and suspension of the operator license.

Respondent, on the other hand, urged that he not be penalized for having exercised his right to a hearing, as he feels the Bureau suggested. The proposed findings then discuss Rolle's physical and mental makeup, largely in terms not supported by the record. The record did verify, however, that threats Rolle had made were subsequently denied or forgotten by him; he worried a lot about having his license revoked; and he has difficulty finding employment because of his huge bulk character, and financial, technical and other," it appears to have activated only the citizenship and technical requirements (Sections 97.37 - 97.49 of the Rules and Regulations). While Rolle's actions are clearly not compatible with the basis and purpose of amateur radio service (Section 97.1), the hearing examiner found nothing in the regulations which would authorize a refusal to issue a station license to Rolle, notwithstanding his reprehensible conduct, so long as he possessed an operators license, nor did the Bureau cite any.

Section 312 of the Act under which this action is taken, paragraph (d), placed a specific burden of proof on the Commission, or in this case, the Bureau. The Bureau has not sustained that burden of showing a proper basis for the revocation of the station license.

The Surprise Kicker

The proposed findings cited no regulation as violated and there was no such identification elsewhere in the record. The allegation of inconsistency with the general standard of Section 307(a) of the Act does not meet the test of Section 303(m)(1)(A). As in the instance of the station license, the show cause order omitted reference to the specific prohibition dealing with profane or obscene words, language or meaning, Section 303(m)(1)(D). According to FCC Examiner Frederick Denniston, *there is no direct prohibition against the use of amateur radio for criminal purposes,* which, if here present, would be conclusive in view of Rolle's criminal conviction for certain of the acts here involved.

The show cause order cited the making by Rolle of "communications of a threatening, abusive and/or indecent nature," and the proposed findings of the Bureau conclude that he had, in fact, done so. This quoted language is a modification of the language of the statute and Section 97.119 of the Rules and Regulations against "obscene, indecent or profane" as used in 28 USC 2464, which both the show cause order and the Bureau eschew, but the Bureau did not explain such a shift in language.

A review of Part 97 convinced the hearing examiner that Rolle's conduct had at least violated Section 97.115 prohibiting the transmission of music, Section 97.125 prohibiting willful and malicious interference, and Section 97.119. The Bureau substitute, which it employed in the show cause order, and the language of Section 97.119, however, have one word in common – "indecent" – one definition of which is "morally unfit to be seen or heard." Rolle's language clearly met this test, and the hearing examiner so concluded. To that extent, the "cause for the proposed suspension" required by Section 303(m)(2) had been properly given and was sustained by the record.

The FCC report summarized: "... the Bureau would revoke the station license on a charge of there being warrant for refusal to grant a license on an original application. The regulations, however, do not specify any basis on which an original application could be actively triggers it with tone. The fact that the user station does have tone would be sufficient to asssure that he is monitoring the repeater output. If the repeater then malfunctions – or its emissions are contrary to the requirements of Part 97 – the user station can shut off his tone equipment to keep further signals from going through the repeater.

Other methods of repeater shutdown include transmission of a carrier for a specified time period (say 3 minutes), transmission of a continuous tone for a specified period (say 10 seconds), or the simple act of refraining from any transmission for a specified period (say 5 minutes). When the repeater is thus shut down, the repeater control licensee can be notified and repairs can be initiated.

If the no-monitor proposal is passed by the FCC, this step would mark the most significant advance in repeater rulemaking since the log-signing requirement was dropped several years ago.

Blind Ham Uses Repeater To Report Blaze

by W1WSN

A QRRR was placed on the WA1KFY repeater in Marlboro, Mass. on November 29, 1970 by W1FCJ, a sightless amateur who reported a fire in his building with accompanying heavy smoke. There was no telephone in the apartment and the FM transceiver was close at hand. The call was received by W1ELU and WA1NPT, who called the Cambridge (Mass.) fire and police departments. W1FCJ remained at his rig until the police arrived and was one of the last persons to be evacuated from the building. There were no injuries, but damage was extensive and heavy losses were suffered by W1FCJ and several other occupants.

refused in the light of the conduct involved; nor does the Bureau indicate a basis outside the regulation which would sustain the action. The charge with respect to the operator license is violation of statute or Commission regulation but the specifications of the charge, "threatening" and "abusive," are found in neither. While the word "indecent" is in the charge and is in Section 97.119 of the Rules, the failure to cite that section, and especially the avoidance of citation to Section 303(m)(1)(D), dealing specifically with "indecent" language on the air, raises substantial doubt as to whether a proper basis has been shown for suspension of the operator license. Surely, the general public and especially the amateur radio operators, who have been subjected to abuse by actions such as disclosed here, are entitled to better protection in the form of clear-cut regulations and supporting procedures to eliminate such activities."

The license for amateur radio station W9FCE was NOT REVOKED, but the Technician amateur radio operator license issued to Armond J. Rolle was SUSPENDED until November 1, 1971

and the U.S. – all the foreign lands receiver better marks for improving their products over the past decade than did the U.S. The best endorsement went to Japan, with 65% of the national sample and 79% of the high-income sample asserting that Japanese goods are better than they were 10 years ago. In contrast, only 33% of the national sample and 27% of the high-income respondents noted improvement in U.S. goods. Furthermore, one-third of both groups claimed that American-made products are not as high in quality as they were a decade ago. This is, by far, the largest negative vote given any of the four nations.

Even while believing that the quality of U.S. products are declining, Americans still have the greatest amount of confidence in domestically produced goods. Of eight products areas surveyed – mostly in the electronics field – only Japan and West Germany approach the U.S. in making products with comparable acceptance to American consumers.

In nearly all products areas surveyed in the Newsweek study, the U.S. maintains a commanding lead over its nearest competitors in both national and high-income samples. In the area of color TV, 76% of the national sample has a "great amount of confidence" in the U.S. product, 25% for second-place Japan. For black-and-white TV the U.S. has a 79% vs 32% "great confidence" lead over second-place Japan. In the category of radio, hi-fi, and tape recorders, the U.S. lead over second-place Japan is 69% vs 48%. The U.S. tops second-place West Germany in watches 62% vs 41%, in small household appliances 72% vs 19% and in automobiles 69% vs 37%.

For further information of this survey and for a demographic analysis of its findings, contact John G. Pontius, Newsweek Home Product Advertising Manager, at 444 Madison Avenue, New York NY 20022.

FCC REPORTS ISSUED

Volume 19 of the Second Series of FCC Reports is now available to the public from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402. Volume 19, covering the period from September 5, 1969 to October 17, 1969, contains 1,140 pages and is priced at $6 (catalog number 1970 O-LT 374-783).

The complete FCC report now consists of the first series of 41 bound volumes dating from July 17, 1934, to June 30, 1965; the second series of 19 volumes covering the period July 9, 1965 to October 17, 1969. Volumes 42 through 45 (covering documents not previously printed in the reports, Safety and Special Radio Services, and Common Carrier Matters) are now in preparation. A cumulative index-digest of Volumes 1 through 15 of the second series is available from the Government Printing Office for $7.50; a similar index to the first series will be prepared.

FCC PROPOSES HIGHER SPEEDS FOR RTTY

Use of higher speeds of 75 and 100 words per minute for amateur radio teleprinter operation has been proposed by the Commission in an amendment to Part 97 (Amateur Radio Service) rules. The present rules permit a speed of 60 words per minute.

The increase was requested by Keith B. Peterson (W8SDZ) and R. Bruce Peters (WB2LRS), who contended that the present commercial teleprinter standards include faster operating models as well as 60 words per minute machines; that the present maximum frequency shift of 900 Hz would not be exceeded, and the higher speed would stimulate the development of new amateur skills and techniques.

The Commission said it believed the use of additional teleprinter speeds in the Amateur Radio Service, in keeping with commercial equipment standards now in use, is desirable and that since increased speeds can be obtained within limits of the present bandwidth requirements, additional interference from the operation was not anticipated.

Comments are requested by March 1, 1971, and reply comments by March 22, 1971.

Action by the Commission December 16, 1970, by Notice of Proposed Rule Making (RM-1392, 1538). Commissioners Burch (Chairman), Bartley, Robert E. Lee, H. Rex Lee and Wells.

New Motorola Hep Functional Circuits

An all-new series of Motorola HEP audio functional integrated circuits are designed to provide a complete audio system for most ham/experimenter projects.

The HEP audio functional circuits are available in three power output levels. HEP type C6004 provides 1W of audio and is priced at $2.60. Type C6005 provides a minimum of 2W and is priced at $4.35. The 4W functional audio circuit is HEP type C6006 and sells for $5.60. All are high-gain devices; they include a preamp and provide full rated output with an input signal in the 10 to 15 mV range. The circuits can be used with 4, 8, or 16-ohm speakers. Mail-order source for Motorola HEP devices is: Circuit Specialists Co. Box 3047, Scottsdale AZ 85257.

Fem-Foto of the Month

Mrs. Nelda Reifsteck (WA9XYZ) became interested in amateur radio as a byproduct of CD activities. She acquired a Novice license in May 1968, and shortly thereafter built a Heath HW16 transceiver.

In May 1970, she received her General license. Again faced with the need of a radio, she built the Heath SB-102 transceiver.

Nelda is active in civil defense work, president of the Women's Civil Defense Council of Champaign County, and president-elect of the Illinois Women's Civil Defense Council. She is reportedly the first woman in either council to obtain a ham license. She has received certificates for completing the civil defense courses in communications, medical self-help, mass feeding, home study course, and package disaster hospital training.

HAM NETWORK AIDS IN MEDICAL EVACUATION

Albrook AFB, C.Z., Nov. 25 — An international network of amateur radio operators in Venezuela, Ecuador, Colombia, New Jersey, and the Canal Zone provided the emergency communications needed to arrange the medical evacuation of a member of the United States Air Forces Southern Command (USAFSO) Band on a good will tour in Maracaibo, Venezuela.

SSgt. Jerald O. Roys, a drummer with the band participating in festivities surrounding a fair in Maracaibo, was discovered on November 18 to be suffering from a possible ruptured spinal disk.

Immediate communication with the Canal Zone was necessary to ensure that the aircraft due to pick up the band the following day was equipped with a special stretcher and proper medical personnel and equipment.

When efforts to contact the Canal Zone through routine government channels were frustrated by uncontrollable delays, band officials sought aid from a local amateur radio station operator.

MSgt. Oscar B. Tinney, an announcer and interpreter with the band, and a ham himself, contacted a Maracaibo eye doctor, Dr. José R. Apitz Rhode, YV1EL, who checked into the "Intercontinental Traffic Net," a frequency encompassing hams listening in eastern North America, Central America, and South America. YV1EL checked in to the net control, a ham in Bogotá, with "urgent" traffic for the Canal Zone.

When the Bogota control station put out a call for the Canal Zone, he found that he was unable to contact anyone. However, WA2CFA, Mr. Selig Rachles, in Clifton, New Jersey, called in to explain that he could reach the Canal Zone and volunteered to relay any messages.

With this contact, YV1EL and WA2CFA contacted KZ5FH, Robert McClain, at Coco Solo on the Atlantic side of the Canal Zone, and the three stations went off the net to try to set up a relayed' phone patch to the Air Force headquarters on the Pacific side of the Zone. While the relay proved workable, phone lines between the Atlantic side of the Canal and the Pacific side are so poor that a phone patch was not feasible.

Meanwhile, and without the knowledge of the other three stations, HC2HV, Helen Jones, in Guayaquil, Ecuador, had been listening to the unraveling drama and the frustrated communication efforts. Helen contacted a Canal Zone station on the Pacific side of the Isthmus and directed him to the frequency upon which the original three hams were attempting to patch their emergency traffic.

KZ5EE, TSgt. Ernest Wachter, came to their frequency and checked in. Sergeant Wachter who lives four blocks from the Air Force headquarters successfully completed the phone patch and the medical attendant and emergency equipment arrived with the aircraft the following day.

When the aircraft returned to the Canal Zone, Sgt. Roys was gently carried from the plane to an awaiting ambulance which was to take him to Gorgas Memorial Hospital. As the sergeant was lifted into the ambulance he managed a smile for his pretty wife, despite the pain, and rode to the hospital little cognizant of the international cooperation of amateur radio operators who came to his aid the night before.

DX BRIEFS...

A2CAK, Des, Box 23, Gaberones, Botswana, on 21013/2000Z. A2CAF says four active stations in Botswana. C21AA, Nauru, on 14130/0600Z, call on CW and he'll move up the band. CE9AT, South Shetlands, Rene, QSL to CE3RR. CT2AK, Jose, Azores, QSL to VE7BWG, on 7030/0830Z. CT3AS, Madeira, QSL RSGB, on 14213/2200Z. EA9EJ, Justo, only active operator in Rio de Oro, no other licenses granted so far, on 14160/0600Z Friday & Saturdays. FP0CA, St. Pierre, 14203/2130Z, QSL to K20JD. HS1ABU, Thailand, Clay, QSL to W5ZG, on 14203/1230Z. KH6NR/Kure, 14230/21295, QSL to KH6NR. ST2SA, Sid, 14220/2200/1330Z, QSL Box 253, Medani,

Clipperton, Anyone?

While Clipperton (FO8) seems to be the most wanted country these days, there are several difficulties ahead for any projected operation from here. You'll find this little French dot on your world map in the Pacific if you look south of Baja California and west of Costa Rica. There is nothing anywhere near it. The weather and the seas pose a problem even in the best months of September and October. Waves that run as high as 40 ft at times and steady winds of 15–40 mph add to the problems. The island is surrounded by a beautiful coral reef, which makes landing

All ARRL Directors Reelected

All incumbent directors running for re-election were reelected. Perhaps, if a little more planning and thought are put into the and Midwest directors will not, I believe, be running again, so changes in those divisions seem inevitable. Will it be a change for the

RTTY NET FORMED

There has now been formed a new section net for Ohio. The mode for this new net is

1971 elections, it will be possible to get in at least one new face! Let's give it a try.

To run for director an amateur must be 21 or over, hold a General Class or better license, and have been a member continuously of the ARRL for at least four years before the date of election. If you know of any amateurs in your area who meet these stringent specifications and also have enough of an interest in amateur radio to offer their services for a two year stint as an ARRL director, it is time right now to start planning the campaign.

Incumbent directors have a tremendous advantage over a newcomer. The average League member votes for the chap that he has at least heard of before . . . and this usually turns out to be the present director. To counter this a new man must spend several months getting around to clubs introducing himself and finding out what they want from him in the way of representation at HQ during those few crucial hours of the yearly directors meeting.

With your help we can all have a bigger and much better ARRL . . . but we must get new faces into those director chairs before any changes are even remotely possible. The 1971 election of directors will give you an opportunity to make changes in the Atlantic, Dakota, Delta, Great Lakes, Midwest, Pacific, Southeastern and Canadian divisions. Some of those, such as the Southeastern, are in unbelievable need of improvement. The Pacific better? That is up to *you*.

The man you run for director must be okayed by the ARRL Executive Committee by the way, and this can take quite a few months if there is even the slightest question that can be raised. No person is eligible who is commercially engaged in the manufacture, sale or rental of radio apparatus capable of being used in radio communications, is commercially or governmentally engaged in frequency allocation planning or implementation, or is commercially engaged in the publication of radio literature intended in whole or in part for consumption by radio amateurs.

Petitions for nomination must have a minimum of ten names of full members of the ARRL in good standing . . . and this good standing should extend to beyond the date for voting in November to be on the safe side. Get the petitions in as early as you can because the Executive Committee may drag out the acceptance of your candidate for several months . . . or longer. One candidate in this last election was held up almost a year, with the decision being rendered a few days before elections, much too late for any possible campaigning. Do you suppose they didn't want this chap in? You bet they didn't!

Even the most vested of interests can be changed if you decide that you are going to take matters into your own hands. Let's work toward getting some new directors, eh?

Chicago Area Hams Hold "Hamboree"

The Chicago Suburban Radio Association, a not-for-profit organization, will hold its annual "Hamboree" on March 21, 1971, at the Operating Engineers Hall, 9200 West Joliet Road, La Grange, (Countryside) Illinois. All Hams and the public are invited. An attendance of 3000 to 5000 is expected, based on previous years.

According to Dean C. Ford (WA9SEF) Program Chairman, 805 S. Stone Avenue, La Grange, Illinois, the latest amateur radio equipment will be on display and sold by major manufacturers and Hams. All Hams are invited to come out and display or sell any products or items they wish free of charge. The exhibit hall has 10,368 square feet of exhibit space. Ample paved parking space will also be available at no added charge.

Drawings for three grand prizes valued at $1000 plus a number of lesser value prizes will be held during the one-day Hamboree. All those who attend will be eligible for the drawings. A donation of $1.50 per person at the door is the admission charge. Advance tickets for only $1 per person, or a savings of 50 cents, may be purchased from:

Mr. Wilson Thomas (W9KWA)
4017 Vernon Avenue
Brookfield, Illinois 60513

REPEATER CONVENTION

The Texas VHF-FM Society will hold its semiannual convention at San Antonio, February 26, 27, and 28, 1971.

This society holds a business meeting, as opposed to a hamfest, and all southwest amateurs interested in the technical aspects of repeater construction and operation should find the Saturday and Sunday sessions very informative.

Among other attractions will be a special program for XYLs and Jr. ops, a family dinner, new equipment exhibits, and prizes.

The San Antonio Repeater Organization will host this convention and arrangements have been made for preregistration at the El Tropicano Hotel, site of the convention. All interested parties are requested to write for a preregistration package. Inquiries should be addressed to:

San Antonio Repeater Organization
P.O. Box 1753
San Antonio TX 78206

PRESQUE ISLE HAMFEST

Don't forget to mark your calendars for the date of Feb. 27, when the Presque Isle ARC puts on its big hamfest. Advance info can be obtained from Box 1021, Erie, PA 16512.

radioteletype. The essential statistics for the net are as follows:

Time	1800 EST (2300 Z)
Frequency	3605 kHz
Meets	Monday through Sunday
First Net	Sunday, January 10, 1971

All through traffic will be handled through the Buckeye Net (CW) representative but dependable liaison must exist with both Buckeye Net and Ohio Single Sideband Net. At present only about half of the available positions are filled so there is still plenty of room if you wish to volunteer for either an NCS or Liaison position. The net roster calls for a total of seven NCS stations and fourteen liaison stations weekly.

The details of net operation are as follows. The NCS will begin the net call-up at exactly 1800 EST. The call-up will be by radioteletype. Stations will then check in by CW. The CW running speed of the net will be 13 WPM but the NCS is instructed to slow down if a station is having difficulty. We do not want to make CW an obstacle in what is essentially a RTTY net. Any directions given by the NCS are to be in CW and acknowledgement of QNI will be in CW. Traffic itself is to be sent on RTTY. The two stations involved in handling the traffic have the option of either obtaining fills by CW or RTTY, whichever is most convenient. Tapes and reperf should be utilized whenever possible to speed up net business. Most small amounts of traffic will be handled on the net frequency but for large amounts of point to point traffic, the two stations should be sent off net frequency by the NCS. A more complete discussion of RTTY traffic handling as it will be done on the net may be found in *The Radio Amateur's Operating Manual*. Incidentally, a "confirm" line at the end of the text repeating the addressee's name and all numbers in the address and text will be expected so please include it.

QRP 10th ANNIVERSARY QSO PARTY

Starts: 0000 GMT Saturday March 13, 1971
Ends: 2300 GMT Sunday March 21, 1971

This contest is open to all amateurs, whether they are members or not of QRP ARC INTL. This contest is for CW only, and all are eligible for awards.

Exchanges: Members: RST, ARRL section or country, QRP number. Nonmembers: RST, ARRL section or country, Power, NM (nonmembers).

Frequencies: CW – 3540, 7040 14065, 21040, and 18040. Novice – 3710, 7160, and 21100.

Scoring: Stations may be worked once per band for this week-long party, for QSO and multiplier points. Each member contact counts as 3 points, nonmembers count as 2 points. As an incentive to participate in this contest, DX QRP members only may claim 4 points per contact. Total QSOs multiplied by ARRL sections or countries worked. There is an additional power multiplier as follows: 100W input X1, 25–100W input X1.5, 5–25W input X2, 1–5W output X3, below 1W output X4; the total is your final score.

Awards: Certificates will be awarded to the highest scoring station in each ARRL section or country. Certificates will also be awarded to the top three places in W/VE, and worldwide (KH6, KL7 DX). The lowest power station in contest submitting a log showing at least three genuine skip contacts.

Logs: Logs must be readable, show date/time of QSO worked, exchanges sent and received, band used, emission type, equipment, power and computation of score. Include a declaration that all rules were observed, and send to Contest Chairman by April 10, 1971. Send to: Elmer J. Worth K3YNN, 946 Franklin Street, Reading PA 19602. Also if anyone wishes information on the QRP ARC it may be obtained by sending a self-addressed stamped envelope to K3YNN.

Sudan. TA3HC, Horace, 28590/1500Z, QSL to XE1EE1. Note: no legal TA stations as yet so do not QSL to Turkey. TR8VW, 28595, QSL to Box 5050, Libreville, Rep. Gabon. Do not mention radio on envelope! VP2KX, St. Kitts, QSL RSGB. VQ9SM, Chagoes, Jacky, 14231/1600Z, QSL to JAØCUV. Also try him 0100-0200 same frequency. YBØAU, Tom, 14058/1100Z, QSL Box 2761, Djarkata, Indonesia. YK1AA, Rasheed, is back on the air Fridays and Saturdays from Damascus, 14228/1300–1600Z long path. ZD5T, Ray, 28590/1800Z, QSL to Box 680, Manzini, Swaziland, Africa. ZK1AA, Cook Island, 14080/0400Z, QSL's. 5U7AR, 21073/1800Z, QSL to Box 442, Niamey, Niger. 8J1RL, 14113/1400Z, Fuku, QSL to JARL. QTH Showa Base, Antarctica. K3QOS/KB6, Canton Island, Odus, 14225/1500Z, listen 0500-0700Z also. QSL to K3QOS. K6AZD/KB6, 14330-35, Norm, 0300-0530Z, QSL K6AZD. KH6AZB/KB6 is also on Canton, up on 10m. UAØYT,14055/0200Z, in zone 23 (as are all UAØY-stations). QSL Box 60, Kzyzl, Tuvinian ASSR, USSR. TR8DG, Guy, 14210/2330Z. VP8LR Falkland Islands, 14214/2300Z, Tony, QSL to WB4FIN. Laccadives expedition set for February 14th with VU2CK-DK-RK-KN operating. They've been trying for this one for years and finally got permission. Few DXers don't need this one so you should be able to hear the pileups even with your receiver turned off. ZD7BB, St. Helena Island, Eric, 14205/0030Z, medium rare these days, QSL c/o Post Office, St. Helena. ZD7SD, Bill, 14210/2100Z, QSL WA2DWE. ZK2AG, Niue Island, 14220/0200-0400Z weekends, QSL ZM4NH, very rare. ZS2MI on again with new operator Fanie, 14192 (listening 14200) 0330Z. Thanks to Gus, WCDXB, and other sources. Any DF info appreciated. Deadline for next issue 20th of month.

extremely precarious. Past visitors have managed to jump onto the wreckage of an LST just off shore. Many unsuccessful attempts have been made to land on Clipperton, only to be foiled by winds, high seas, and unbelieveable ocean currents.

To further complicate the problems, recent reports from commercial fishermen in the area indicate that two French naval vessels are there, one a minesweeper type and the other a helicopter ship. Fishermen approaching the island are headed off. There appears to be a crew ashore working and living on the island with a new bunker under construction. It is also reported that those in authority to give permission to land are extremely difficult to contact.

The last time Wayne Green visited the Clipperton licensing authorities in Tahiti (in 1966) he found his FO8AS Clipperton license to still be valid. Since then he has not had the time or the money to organize an expedition, but has been in contact with others interested in the trip, hoping to be able to go along. Nothing is definitely in the wind as yet..

Swap 'n' Shops

The 4th annual Blossomland Amateur Radio Auction and Swap 'n' Shop! will be held Sunday, March 14, 1971 at the Shadowland Ballroom, Silver Beach Amusement Park, Benton Harbor–St. Joseph, Michigan. Doors open at 9 AM EST.

Over 1000 amateurs turned out last year for Southwestern Michigan's fastest growing ham event . . . and went away with carloads of good gear (and money). This annual auction has grown from less than 100 attendance in 1968 to over 1000 . . . and this year promises to be a lot bigger!

Half an acre of indoor space will be available for the Swap 'n' Shop and auction to accommodate the trailerlaods of bargains that will show up. Hot food . . . indoor restrooms . . . acres of free parking . . . drive-up unloading . . . you name it and we've got it.

Coming from out of town? Just follow Interstate 94 into Benton Harbor – St. Joseph from the east or west; get on U.S. 31–33 if you're coming from the south or north.

Check your schedule and shack now . . . and be at the Benton Harbor Ham Auction on Sunday, March 14. You really can't afford to miss it!

The Huron Valley Amateur Radio Association 4th annual Swap 'n' Shop will be held on Sunday, March 7, 1971 from 9 a.m. to 5 p.m. at the Pioneer High School, Stadium and Main Streets across from the University of Michigan football field, in Ann Arbor, Michigan. Adequate free parking, easy access, an auction, and many surprises. Talk-in on 146.94 FM and 3930.

Donation is $1.25 in advance, $1.50 at the door. For further information write W8KGG 2729 Packard Road, Ann Arbor, Michigan.

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business venture. No display ads or agency discount. Include your check with order. Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February. Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads. We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue. For $1 extra we can maintain a reply box for you. We cannot check into each advertiser, so Caveat Emptor. . .

MOTOROLA FM - 2 meters; U43GGT, 40 watts output, transistor supply, very clean, with cables and control head, less crystals - $145. 80D Transmitter strip - $15. Sensicon A Receiver - $20. Complete 80D, Dynamotor supply with cables and head - $40. WA1INO, P.O. Box 587, Manchester CT 06040.

IMPORT AND SAVE $$$. Japanese ham gear catalog- $2.00 (Refundable). Over 60 rigs illustrated. K4EPI, R. Guard, Box 99, Dept. 73, Lacey's Spring, Alabama, 35754.

JIG SAW PUZZLES WANTED. Lover of those wooden jig saw puzzles is looking for any that might be still around in your attic or closet. There used to be thousands and thousands of them so there must be a few left. If you have some that you would like to find a good home for, write to Wayne Green, Peterborough's most avid jig saw fan, Peterborogh NH 03458. State price, if any.

OHIO- Intercity Radio Club is holding their Annual Ham Auction Friday Feb 5 at the Naval Training Center, 170 Ashland Rd., on U.S. Route 42, in Mansfield, Ohio. Look, swap, buy at 7:30 P.M., Auction at 8:00 P.M. Eats. Eldon Heck W8PO, Rt 2, Box 195, Shelby OH 44875.

WAYNE, LIN, KEN and the entire staff of 73 wish you a superbly joyous Groundhog's Day, Washington's Birthday and Lincoln's Birthday. Frankly, unless you have a currently valid subscription, only a few of us have good wishes for the rest of the days of the month. Our very best wishes can be obtained on a temporary basis by means of a gift subscription for a friend.

HEATH SB-310 RECEIVER,mint, professionally aligned, deluxe SSB crystal, plug in crystal for 15 M novice band, $235. William L. Reeve WB9DVV, 335 No. Elmwood Lane, Palatine IL 60067.

ELECTRIC ORGAN, basic spinet kit, transistorized, known make, limited supply, send SASE for particulars. L. G. Hanson W9YCB, RR 2 Box 52A, Angola IN 46703.

TINY LIKE-NEW HANDIE-TALKIE. HT 220 OMNI; Motorola's latest pocket transceiver. About 6½ watts rf out, two tone freqs (1950 and 2100 Hz); crystaled and operating on 146.34/146.94 and 146.94 "direct." Receiver very sensitive (0.25μV for 20 dB of quieting). Includes Ni-Cad battery and new Motorola charger. $550 cash. Ken Sessions K6MVH, 73 Magazine, Peterboro NH 03458. Phone 603 924-3873 (at work).

MAGAZINES. Fifty year personal collection of ham radio and photo publications. Also gear. SASE. Jack Stuart W53G, Box 991, El Paso TX 79946.

SWAP excellent R-390/URR for 5-band transceiver plus $375. Will pay shipping anywhere. Roland Guard K4EPI, 750 Lily Flagg Road, Huntsville AL 35802

2M FM GALAXY FM210 with AC power booster and two sets of crystals and manual. $195. John Stiles K7DGV, Box 114, Sweetgrass MT 59484.

WANTED: COLLINS 51 J4 or 51 S1 receiver in good condition. M. Eisenber, P.O.Box 5171, Los Angeles CA 90055.

FOR SALE: H.T.37 excellent cond. $160. Viking Valiant $75, excellent, with mike for P.T.T. SX101 MK III, extremely clean $90. All FOB. Phone 904 264-2738. R. L. Sturgis WB4BYJ.

VHF DISCONE ANTENNAS. New surplus AS-408/U discone antenna covers 200 to 400 MHz. Will ship postpaid. $22.50. Frank Hajdu, 41 Ledge Lane, Stamford CT 06905.

FOR SALE: John F. Rider Radio Troubleshooter Manuals, Vols. 1 to 17, approx. 75 Sams Folders, loads of TV and Radio manuals such as RCA, Philco, Zenith and others; Simpson 325 Signal generator, Eico 425 Scope, Eico 360 Sweep Generator, Heathkit Signal Tracer, 25 Relays and other parts. The whole works for $400 FOB Bronx NY. Tel. 212 652-2416 (evenings). Jack Naimann, 201 E. Mosholu Pkwy, Bronx NY 20467..

FOR SALE, highest offer takes following ppd.: Knight TR-108 2-meter transceiver with Heath HWA-17-2 FM converter; Globe HG-303 75-watt 10-80 meter transmitter; Eico HF-81 stereo preamp, 488 electronic switch, 1020 power supply, 221 VTVM, 950-B RC comparator and bridge, 460 scope; Heath MP-10 12-volt to 110-volt inverter, SG-8 signal generator, TC-3 tube checker; Ballantine 314 audio VTVM; Fisher 50-C-4 mono preamp; Ten-Tec PM-3 transceiver with AC-5 antenna tuner. Also for sale, complete professional home burglar/fire alarm system, never installed, send s.a.s.e. for data sheet and description, Pete Stark, Box 209, Mt. Kisco NY 10549.

1971 AMATEUR ALLOCATIONS

TECHNICIAN

CW & PHONE: 50.1–54.0, 145–147, 220–225, 430–450, 1250–1300, and up.

GENERAL

CW: 1800–2000, 3525–3800, 3900–4000, 7025–7200, 7250–7300, 14.025–14.200, 14.275–14.350, 21.025–21.250, 21.350–21.450, 28.0–29.7, 50.1–54.0, 144–148, 220–225, and up.*
PHONE: 1800–2000, 3900–4000, 7250–7300, 14.275–14.350, 21.350–21.450, 28.50–29.7, 50.1–54.0, 144.1–148, 220-225, and up.*

ADVANCED

CW: 1800–2000, 3525–3800, 3825–4000, 7025–7300, 14.025–14.350, 21.025–21.250, 21.275–21.450, 28.0–29.7, 50.1–54.0, 144–148, 220–225, and up.*
PHONE: 1800–2000, 3825–4000, 7200–7300, 14.200–14.350, 21.275–21.450, 28.5–29.7, 50.1–54.0, 144.1–148, 220–225, and up.*

EXTRA

CW: 1800–2000, 3500–4000, 7000–7300, 14.000–14.350, 21.000–21.450, 28.0–29.7, 50.0–54.0, 144–148, 220–225, and up.*
PHONE: 1800–2000, 3800–4000, 7200–7300, 14.200–14.350, 21.250–21.450, 28.5–29.7, 50.1–54.0, 144.1–148.*

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LISTING SERVICE- Gear to sell? Need rig? Sellers- $1.00. Lists information year. Buyers-free. SASE brings details. Listing Service, Box 1111, Benton Harbor MI 49022.

73 Everywhere

I guess you people at 73 never realized how popular your magazine really was. They even named beer taverns and billiard parlors and barber shops after this famous rag. It seems that after they built N.J. state highway 72, they had to name the next one "73".

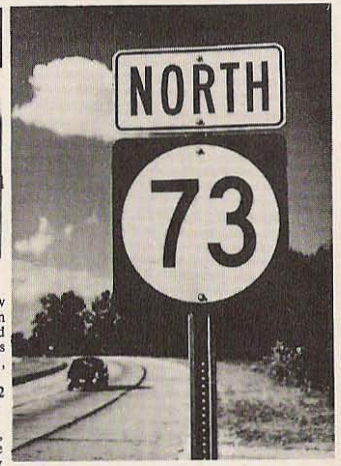
E. L. Klein Jr. WB4AYE/2

Think!

I like 73 technically and informationally, and occasionally editorially. Ken and Wayne serve a purpose in keeping the fraternity stirred up with their sometimes caustic comments. THINK and then ACT! If you believe in a program, proposal or whatever, don't just sit back and let George, Joe, Tom, Dick or Harry do it – do it yourself! I happen to be one of those who agree with incentive licensing. It got me off my duff to get the Advanced, and when I finish the three courses I am currently enrolled in I plan to go for Extra. My field is administration, so anything I know about amateur radio is strictly self-taught or taught by my fellow hams more generously blessed with talent. For me it comes hard, but I will make it.

Please advise your readers that I have answered nearly all the QSLs received for KM6DU/KH6 (Kure Island) and anyone who has not received theirs by this time should QSL via K7UNB (direct or bureau) and I will answer sometime after March, as I will be in transit until then. I answer all cards received, SASE/IRC or not. A number of cards have probably been lost in the mail, a not uncommon occurrence from indications. One party after his fourth try wanted to know if I really existed. Sorry 'bout that. A few have referenced QSOs for times/dates KM6DU was not on the air either from Kure or Midway – either a mistake or a pirate.

Hal Thompson
Rt 3, Box 1530
Roseburg OR 97470



After reading Never Say Die and Letters in the December issue I am forced to add my two cents' worth. Early last spring I wrote 73 about FM oriented articles appearing to the exclusion of all others. At this writing, the editorial and news pages continue to center on FM; and while the balance in article subject matter is better than it was it is still slanted to a small segment of ham activity.

A quick check of total pages shows 1970 to be behind 1969 by almost a full issue. This alone is bad enough but when you delete the "arty look of articles" there is even less of redeeming value.

It would seem that Mr. Sessions is more qualified to conduct the Radio Today side of the business with perhaps a monthly FM column in 73. This would leave the remainder of the enterprise to someone with the knowledge, desire, and capability of conducting a magazine devoted to amateur radio. Perhaps it would not allow trips to Jordan and the like but I am convinced that Wayne's personal efforts continue to be necessary to the editing and selection of subject matter for 73.

Bill Turner WA0ABI

Compare 73's 1970 page count with our nearest competitors and you'll find we're still way ahead. Why not give FM a go, Bill. Five will get you ten you'll get hooked, too.

. . .Ken

WANT TO BUY: TS239 (LaVoie 239) manual. David Potter, 2844 San Gabriel, Austin TX 78705.

FOR SALE- HT 37 $150, NC 270 $75, both for $200. Johnson TR Switch $15. Charles E. Bailey W9HUX, 915 Doolin, Jacksonville IL 62650.

G. E. POCKET RECEIVERS Model SB03VE6. Operates with tone or normal squelch, Exc. condition $50. Lou Miniver WA7KRP, 1975 No. Yellowstone, Idaho Falls ID

GET YOUR "FIRST!" Memorize, study – "1970 Test-Answers" for FCC First Class License, plus "Self-Study Ability Test." Proven. $5.00. Command, Box 16348-S, San Francisco CA 94126.

FLYING HAMS: Trade your excess gear for avionics equipment. All lines available in the box or installed in your aircraft. All fully warranted. Interested in all lab test equipment, ham or military type gear. Powell Avionics, FAA Repair Station #711-1, Box 106, Fayetteville NC 18302. 919-484-0236, nite 483-9426.

MANUALS— R-390/URR, R-390A/URR, USM-24C, BC-639A, SP-600JX, BC-348JNQ, URM-25D, UPM-45, UPN-12, OS-8C/U, CV-591A/URR, BC-779B, TS-186D/UP, TS-587B/U, $6.50 each. S. Consalvo, 4905 Roanne Drive, Washington DC 20021.

GALAXY FM210 with AC210, mobile antenna, microphone, xtals and FET preamp. $250 or best offer. WB2DMU, 4767 Lake Rd., Burt NY 14028.

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NEW 4-1000 A, socket, chimney, and filament Xformer, $110. RCA CV-57 Converter. Almost new $75. PCA-2T Panadaptor, 455 kc 200 cycle, and manual. $45. Write 4183 Lonnie St., Oceanside CA 92054.

THE 20th ANNIVERSARY DAYTON HAMVENTION will be held on April 24, 1971 at Wampler's Dayton Harra Arena. Technical sessions, exhibits, hidden transmitter hunt and an interesting program for the XYL. For information write Dayton Hamvention, Dept 7, Box 44, Dayton OH 45401

LAST CALL FOR 1963 73. Bound volumes of 1963, regularly $15, while they last only $7.50. Act now! 1963 was a very good year. 73 Magazine, Peterborough NH 03458.

FOR SALE: Heath "Sixer" with push-to-talk, output meter, power supply, halo antenna, manual. $40 or best offer. Bud Michaels WB2WYO, 713 High St., Victor NY 14564.

2M FM- MOTOROLA D43GGV- Excellent condition with crystals, preamp and tuned up transmit 146.34, 146.94, receive 146.94. $85. Motorola R394 receiver with AC power tuned with crystal, spare tubes 146.94. $35. John L. Sielke K3HLU/4, 320 S. Macarthur Ave., Panama City FL 32401.

SELL mint, A-1 Collins KWM-2, AC supply and speaker, 301-1. Belongs to estate of the late K4FLI. Mike Burkhead, RFD 1, Henderson TN 38340.

RECEIVERS: RBA, RBB, RBC with power supply and cable. Also, R-511ARC. 190-550kc, R-509ARC 108-135mc, SASE other items. J. Lisaius, 116 Orton Rd, W. Caldwell NJ 07006.

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GSB-2SSB SOLID STATE TRANSCEIVER, perfect condition, no trades, best offer. Bob Gilmartin, 1715 Diana Blvd, Merritt Island FL 32952.

LETTERS

Nincompoops

Ref. Dec. 73 contents page *Receiver Offset Tuning, etc.*, who is the egotistic ignorant, punk nincompoop responsible for the subhead for this article, *"For tuning in oldtimers who can't stay on frequency."*

Reminds me of the type of character who, if he can't see it, touch it, smell it or taste it – it isn't. Nothing happened before he was born. If he doesn't know it, it isn't. The mark of not only the common man but of a character contemptuous of the older people who made ham radio in the first place, men who didn't memorize test articles in magazines, but who had to dig out the information almost alone. This type of oldtimer didn't pass a memory test, run down to the nearest equipment emporium, buy a package and an antenna and mike, then go on the air to yak for the rest of his life, never building anything except possibly a kit where you need to know nothing and above all, you learn nothing.

I will wager that any hundred oldtimers will burn the long hair, beards, and sideburns off any equal number of characters such as who made that subtitle, in any test of "being on frequency." Any takers?

What do you say?

Harold L. Feighner W8BPB
5210 Three Mile Drive
Detroit MI 48224

I am the nincompoop that wrote the subhead. My hair is not particularly long, no remarkable sideburns, and no beard at present. (You didn't like Monte Wooley?) If there are any OOTCers or QCWA members whose sense of humor has atrophied enough to accept an apology for my remark they may have it. Now Harold, if you will start tuning our phone bands a bit, you will find that oldtimers like you and I are often off frequency. Have you ever listened to 3999?

. . .Wayne

I Won!

Many thanks for acting so promptly on my request for your book, *Take Your Traffic Ticket to Court and Win.* It came within three days of my request and I am delighted to say that it gave me the courage and know-how to go to court and defend myself.

My performance would never have won any Oscars but it won from the judge a most pleasant "case dismissed."

Mahalo to you and my best alohas.

Tom Doyle

Wish I'd got off that easy. Narrowly missed getting hanged.

. . .Ken

What's Been Happening?

Living in Wyoming and devoting my time to educational TV and radio I have kinda lost track of amateur radio. Even tho I have an amateur Extra ticket I have not been on the air for about 3 years. Several questions have come to mind over the years which I'm sure your mag will help answer – such as: Does the ARRL still exist? Do we still have 80 & 40 meters or do we now operate on some SHF freq. etc. etc. It seems most hams around here are not aware of operation below 144 MHz and are working very hard putting in repeaters etc. etc. in order to communicate a hundred miles or so. I mentioned lower freq but they looked at me like I was stupid! I must admit I am not knowledgeable on current amateur happenings. Please fill me in.

Dave Worley W7BQY

Three years? Little has changed. ARRL, last we heard, is still around. Repeaters are becoming epidemic – better look into it.

. . .Wayne

FM Clubs

I read your magazine every month and especially enjoy articles related to FM operation on 2 meters.

Can you tell me what amateur radio clubs are located in the New York City metropolitan area, what clubs in my area use 2 meter FM as their sole method of operation and what repeater stations are in the Brooklyn/Btonx, New York area, in addition to their frequencies.

I want to join up with a local club and especially want to learn more about FM communications on the ham frequencies.

Douglas Townsend
Graphic Services
The Rockefeller University

Can't say about the clubs. For repeaters, you have several: K2OOP on .22/.82; K1TKJ on .25/.73; K2HOI and others on .34/.76; simplex on .94.

. . .Ken

Wayne for League Manager

I think Wayne Green is about the only person who can save ham radio. At least he is the only one who seems to be really trying. I don't think too much of K2AGZ sometimes (very often) but I suppose you have to have someone controversial on the staff (someone else, that is, so the guys let up on Wayne a bit).

Mike Czuhajewski WA8MCQ

What's The Beef?

I have only read a few of your magazines, but I can tell at a glance you are 100% anti ARRL. What's the big beef? If you don't like the way ARRL does things and you think you can do it better and have the support of the majority, start your own group and send people to Washington, etc. If the League has so much money you ought to be able to raise much more because you have so many on your side. I have only been in ham radio a few months, and all I know is that if I get my General or Advanced ticket it will be because of books and helps put out by the League.

I was copying W1AW code practice and a bunch of lids got right on freq. and loaded up and sent a bunch of gibberish (not one call sign so anyone would know who they were) just to louse up W1AW. That really takes "brains". You *ANTI* people make me sick. You are just like these kids that are against the Establishment, but don't have any reasonable alternatives, except to tear down and destory. Sure the ARRL isn't perfect, but until you blowhards get off your soap boxes and start a better League, it is the only thing we've got.

Thanks for letting me blow off a little steam.

Jim Nilson WN9ETH
4412 Marsh Ave.
Rockford IL

Where do you think ham radio would be today if the League was allowed to go unchecked? If the League had its way in 1967, Generals would not be permitted to use phone.

. . .Ken

New Repeater?

For a while I have heard a rumor that someone is putting one on the TV tower on Mt. Ascutney. Ascutney is visible from my house and results should be very fine, but I can't find out if such a repeater is indeed in operation or the frequencies they use. Do you have any info on this one?

Bill Deal K1CLD
Piermont NH 03779

Mt. Ascutney repeater is WA1KGM and operates by relaying FM signals from 146.16 to 146.76 MHz. The coverage is superb (4 states).

. . .Ken

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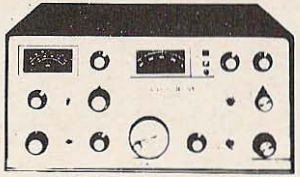
NCX-1000



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During the past several years, a number of metal locators have been described in technical literature. An excellent example is the constructional article which appeared in the July '67 issue of *Popular Electronics*. The design philosophy of these locators has been directly inherited from vacuum-tube technology; it has generally been found that a decided upgrading in performance could be reliably attained from the mere conversion to solid-state circuitry. Nonetheless, I have long felt that a little imagination might be profitably unleashed toward a somewhat *different* approach to the electronic detection of metallic objects. After ruling out "change for change's sake," the reasoning evolved as follows: The transistor AM radio has become such a popular item that actual replacement is now the accepted "servicing" method. Why not use the very considerable amplification available from even the most inexpensive of these sets? And, to make the project just a bit challenging, why not stipulate that *no surgery of any kind be permitted on the set?*

Shortly after formulation of this idea, it was discovered that a superficially similar approach had been anticipated and implemented by others. However, in all situations investigated, there was either *dependency upon a broadcast station*, or *modification of the radio's circuitry*. These techniques were rejected as undesirable. One, then, was left with the clear objective of developing a scheme which would enable the deployment of *any* transistor radio in an arrangement capable of providing a response to metallic objects: This would be accomplished *without electrical connection to the set*, and would involve *no operational dependency on broadcasting stations*. (An added feature of such stipulations is that the radio could be immediately used for its intended function if so desired.) Not only were these objectives achieved in a straightforward manner, but performance definitely exceeds that generally obtained from the conventional locator. The ensuing discussion describes the theoretical and practical reasons why this is so:

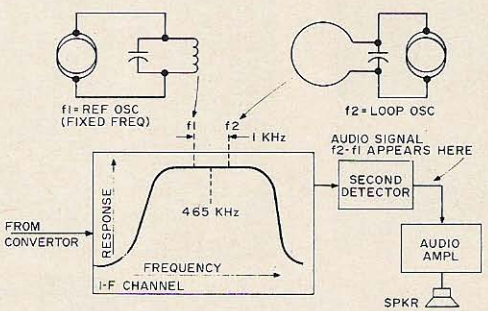


Fig. 1. Block diagram depicting basic concept of locator. The two oscillators are "radiation-coupled" to receiver's i-f channel. Converter plays no role in this scheme, and tuning is of no consequence except that it is desirable to be tuned between stations to avoid their interference. ference.

Principle of Operation

The principle of operation involves "immersion" of the transistor radio in *two* electromagnetic fields. Both of these fields are at frequencies within the passband of the i-f amplifier of the radio. (Because of the proximity of the oscillators which generate these fields, we have considerable latitude with respect to where these frequencies enter the response curve of the i-f amplifier.)

The field produced by one oscillator is at a *fixed* frequency during a search for a metallic object. This frequency is generated by the reference oscillator (Fig. 2) and consists of the circuitry associated with Q2. The field produced by the other oscillator (Fig. 3) is subject to "pulling" by the effect of eddy currents induced in a

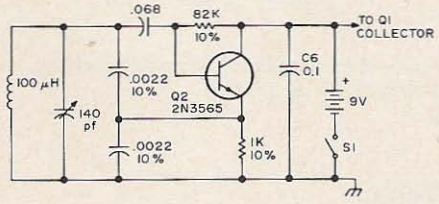


Fig. 2. Schematic diagram of reference oscillator. This oscillator is situated inside the box on the handle.

metallic object when it is approached by the exploratory loop. If the two frequencies are initially different by an audio frequency, say 1 kHz, a change of pitch will be heard from the radio speaker. The audio tone is actually a heterodyne product of the two interacting frequencies, and is generated by the second detector of the radio. One might say we have harnessed one of the ancient plagues of the superheterodyne circuit, the "birdie." But, unlike inadvertent ones, this deliberately created birdie is extremely strong and stable.

It will be noted that the customary multiturn wire loop has been replaced by a single turn of sturdy copper tubing Those with experience in the construction and operation of locators will quickly grasp the significance of this innovation. Not only is the winding to a wire loop attended by

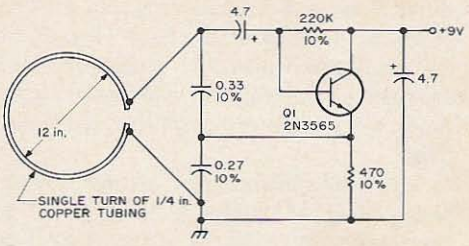


Fig. 3. Loop oscillator schematic. This oscillator is situated directly between the ends of the single-turn loop.

danger of shorted turns and difficulty in reproducing an author's results, but such loops often contribute greatly to the overall instability of the locator. Usually, physical disturbances, difficult to avoid during exploration, cause abrupt frequency shifts, thereby masking the sought response. Indeed, despite the continuing controversy over optimum loop size and exploration frequency, the major impediment of detection sensitivity has always been *mechanical and electrical instability*. For this reason, the single-turn loop is, in itself, a worthwhile improvement. Moreover, because of the extremely low impedance of such a loop, no electrostatic shielding is necessary! Thereby, we avoid degradation of sensitivity from the eddy currents induced in a shield.

Prelude to Construction

The locator is comprised of three basic functional blocks: the loop oscillator, the fixed oscillator, and the transistor radio. From a constructional viewpoint, we are concerned primarily with the two oscillators. Our involvement with the transistor radio is simply the mechanical one of providing a suitable mounting for it on the handle of the locator. If we are successful with the oscillators, their fields will penetrate the radio and the locator will be operational. So, let us commence with the loop oscillator.

It has already been mentioned that the loop oscillator uses a single turn of copper tubing in its resonant tank. Another unique feature is the physical location of transistor Q1 and associated components. These are

situated on a PC board (Fig. 4) directly between the ends of the loop (Fig. 5) so that we do not have the usual separation between active element and tank circuit. This, too, enhances stability and sensitivity.

The inside diameter of the nearly complete circle of copper tubing is 12 in. Approximately 2 in. of space is allowed between the ends. This space is occupied by the PC board containing the remaining parts of the loop oscillator.

The use of a high-beta transistor and Mylar capacitors results in a sure-fire and stable oscillator in the 450 kHz region, despite the extremely low impedance of the single-turn tank circuit. The tubing should be protected by some type of sleeving ("spaghetti" or heat-shrinkable tubing).

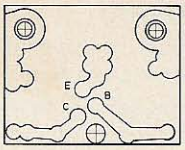


Fig. 4. Loop oscillator (circuit side).

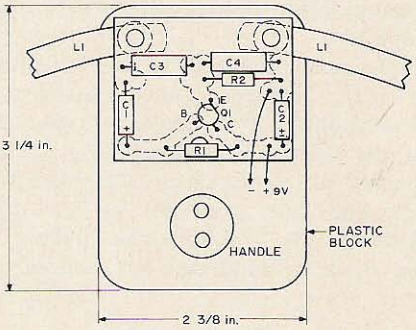
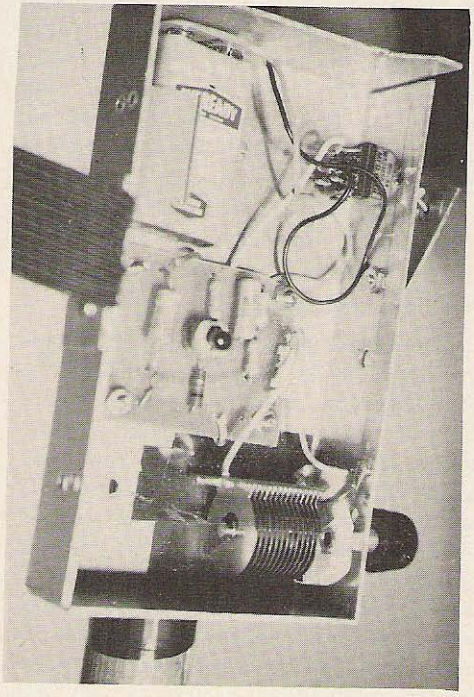


Fig. 5. Mounting block, showing association with loop oscillator and handle.



Reference oscillator — inside view with cover plate removed.

Oscillator

The reference oscillator utilizes transistor Q2 in a Colpitts circuit similar to that of the loop oscillator. A quality air variable capacitor is provided for frequency adjustment. Such a capacitor is *greatly superior* in mechanical and electrical stability to the movable-core inductors commonly used in metal locators. However, relatively small tuning-range results from its use. This is actually desirable from the standpoint of stability. Because the large tuning range associated with a movable-slug inductor is not obtained, it is mandatory that the prescribed components, or their equivalents, be selected both for the reference oscillator and the loop oscillator. On the other hand, the reproducibility of the loop oscillator renders it unnecessary to incorporate a wide tuning range for the reference oscillator. The reference oscillator circuit board (Fig. 6) is situated on the handle, adjacent to the transistor radio. A single 9V battery powers *both* oscillators. As with the loop oscillator, it is very important that *all components be securely*

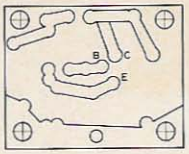
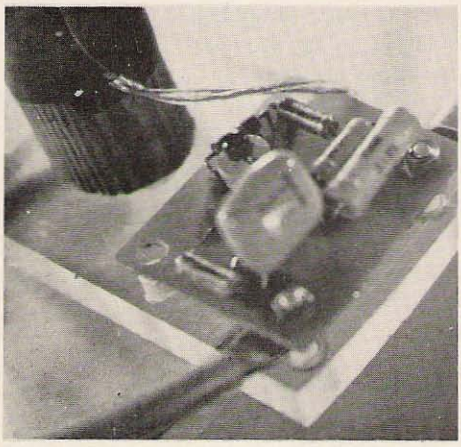


Fig. 6. Reference oscillator (circuit side).

mounted. This requirement tends to "come along for the ride" as a consequence of the printed-circuit board. In the event a different construction technique is used, it should be realized that any relative movement of the components or connecting wires can diminish the usable sensitivity.



PC board and loop ends are attached to clear plastic block. This block also supports the handle. (Speaker cord goes to battery and switch which are contained in the handle-mounted reference oscillator box.)

Transistor radio is strapped to box; a single turn of copper tubing makes the exploratory loop. The novel principle of operation renders unit independent of stations, nondirectional, and highly stable. Overall result is enhanced sensitivity and exceptional ease of operation.

Notes on Operation

Before commencing operation, it is essential that it be understood that broadcasting stations do not play any part in production of the search tone. Indeed, the reception of a station constitutes interference and tends to mask the pitch variation which signifies proximity of a metallic object. Therefore, the radio must be tuned to a spot *between* stations, or preferably set at the extreme low frequency end of its tuning range. In any event, when the loop oscillator and the reference frequency oscillator are within an audio frequency of one another, that audio frequency will be heard over the *entire tuning range of the radio*. Also, there are no directivity effects; neither the pitch nor the amplitude of the tone changes with orientation of the locator until one approaches a metal object with the exploratory loop.

Three modes of operation are possible, depending upon whether the reference oscillator is adjusted slightly above, equal to, or slightly below the frequency of the

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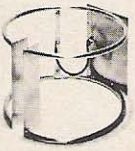

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loop oscillator. I favor the third-mentioned mode, with the tone adjusted to the 500–1000 Hz region. Then an approach to a metallic object will cause a rise in pitch. This locator is *entirely free* of "pulling" between the two oscillators which, in conventional locators, often causes a marked reduction in sensitivity.

Troubleshooting

If, with the transistor radio strapped to the reference oscillator box, adjustment of the variable capacitor does not bring forth the audio tone, both the reference oscillator and the loop oscillator should be checked for oscillation. This is easily accomplished by means of an oscilloscope. Probe the base of Q1 and Q2; if there is no evidence of oscillation, make a methodical investigation of the connections, the components, battery polarity, etc.

The most probable cause will involve the ability of the reference oscillator to tune sufficiently close to the frequency of the loop oscillator. This could come about if the Mylar capacitors associated with the tank circuits deviate more than the prescribed ±10%. Obtain three capacitors with the following capacities: .01, .03, and .047 μF. Parallel one of these at a time with the .33 μF capacitor in the loop oscillator. Each time tune the variable through its range. (The radio should be tuned to the low frequency end of its range and its volume control fully advanced during this troubleshooting procedure.)

If results are still not forthcoming, remove the additional capacitor and go through a similar procedure by connecting three different capacitors across the upper .0022 μF capacitor in the reference oscillator circuit (Fig. 2). These capacitors should be 100, 330, and 470 pF, respectively.

A considerable frequency range will have been covered by these two procedures, and a loud bell-like heterodyne is certain to be produced if all circuitry is properly installed.

I investigated 12 new 2N3565 transistors for the loop oscillator. All but one proved to be vigorous oscillators. The marginal one was found to have the lowest beta of the dozen; this one showed a beta of 130 for a collector current of 1 mA. All the rest displayed values within the range of 220 to 480.

Additional Notes

The cover plate for the reference oscillator should be made of fiber glass, Vector board, Lucite, or other insulating material. *Metal must not be used.*

Polycarbonate or polystyrene capacitors of the specified tolerance could be used in place of the Mylar capacitors in the tank circuits of both oscillators. However, the metalized versions of any of these dielectrics should not be used.

The fact that no shielding of the loop is required can be readily demonstrated by putting one's finger on the "hot" end of the loop. A negligible change in the pitch of the audio-tone is produced. This, of course stems from the extremely low impedance of the loop. Conversely, it is, as desired, very sensitive to *electromagnetic* disturbance of its resonant frequency.

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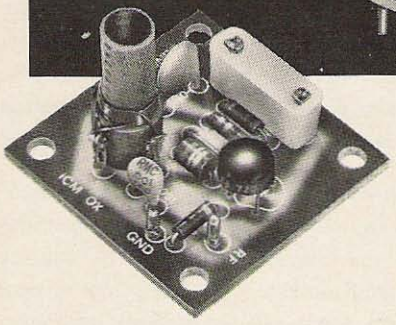

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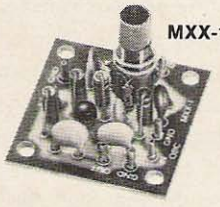

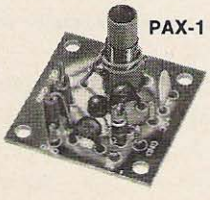

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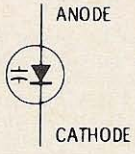
Practical circuit applications using that strange diode: the varactor

by BILL MENGEL

The varactor is a simple two-terminal device extending dependable operation in the VHF, UHF, as well as microwave frequencies by utilizing the voltage-variable capacitance of a pn junction. The varactor provides a way of tuning circuits, multiplying and dividing frequencies, controlling frequencies, and performing other functions. A varactor, which is a special-purpose junction diode, has been designed to make its junction capacitance useful; it is because of this property of a varactor that capacitance, which is an unavoidable nuisance in conventional diodes, is purposely cultivated into the varactor. The basic configuration for the varactor is shown in the illustration below.



The operating portion of a varactor is in the region where a conventional diode would be considered to be cut off — principally in the region between forward conduction and reverse breakdown. In most cases, the varactor is reverse-biased since in this state it draws a minimum of current, making it essentially voltage-operated. The behavior of the pn junction of the varactor at different applied bias potentials is as follows:

ZERO BIAS — At zero bias, the contact potential is determined by the semiconductor. There is no change in capacitance and no current flowing at this time.

FORWARD BIAS — When forward-biased, high forward current flows as the external voltage applied is in series with the contact potential. The contact potential decreases thus increasing the capacitance.

REVERSE BIAS — When reverse-biased, the external voltage applied is in parallel with the contact potential. The contact potential increases, extremely low reverse current flows, and the capacity decreases.

The property of being able to vary the capacitance by changing the applied voltage enables the varactor to do the work of a conventional variable capacitor many times its size. The capacitance of a varactor varies inversely as the reverse voltage, and directly as the forward voltage. It may also be noted that the capacitance of a varactor also varies nonlinearly. Varactors also have a Q approaching that of air trimmer capacitors, so they could be used in such locations as rf front ends and high-efficiency multipliers as well as other normally sensitive circuits.

The varactor diode by itself is unique in frequency multiplying and dividing. First, the rf signal itself is the only power required to operate the varactor. Secondly,

the varactor, by distorting the input signal develops an output rich in harmonics. Thirdly, a varactor can provide a means of high power output at frequencies normally beyond the limits of present power transistors. In frequency multiplication, it is only a matter of placing a tuned circuit (tuned to the input frequency) on one side of the varactor and placing another tuned circuit on the other side tuned at the desired harmonic. As shown in Fig. 1, the input circuit is tuned to frequency f. The output of this circuit is then fed to the varactor where it is distorted. This distorted output is then fed into an output circuit tuned to frequency f(n)out.

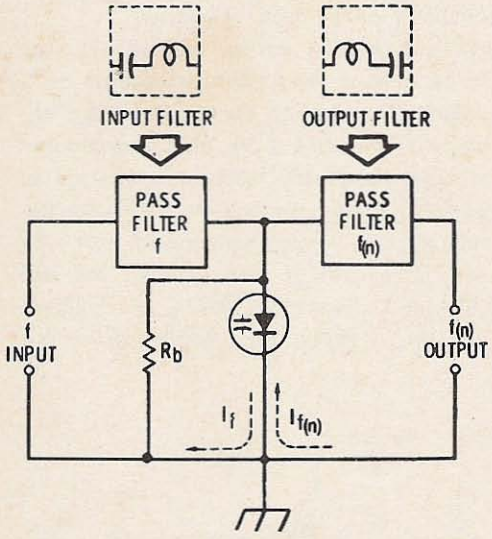


Fig. 1. Frequency multiplication.

In typical frequency doublers, efficiencies as high as 90% — as compared to the 50% efficiency of conventional tubes and transistors — can be realized. This can be attributed to the fact that a varactor dissipates very little power and has low loss. A properly designed varactor multiplier does not generate noise. However, parametric oscillations can occur from highly overdriven varactors or from unwanted

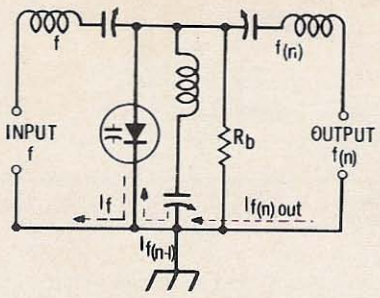


Fig. 2. Postdoubler multiplication.

idler resonances. A bias resistor Rb (shown in the above diagram) will usually have a value of from 68K to 270K. The higher values of resistance make the circuit more efficient while the lower values of resistance make the circuit operate more linearly.

Since average capacitance varies with input power applied, some detuning will occur if the input power to a multiplier using a varactor is changed appreciably. All frequency multipliers beyond a doubler require an idler circuit for maximum efficiency. An idler circuit is used to reinforce the output frequency of a multiplier. This is done in the following manner. The current developed by the idler circuit is added to the fundamental current to form the harmonic current. The tuned frequency of an idler is generally set to one harmonic below the output frequency, as illustrated in Fig. 2.

A basic example will now illustrate the principles of operation of a typical varactor circuit. Our problem is that we want to take a present signal of, say, 150 MHz and develop an output of 450 MHz.

Referencing Fig. 3, capacitors C_2 are used to match the input and ouput of the tripler to the input and output impedances. With an input frequency of 150 MHz, the input filter is tuned to a frequency of 150 MHz. A type 1N4387 varactor is chosen. This varactor is capable of 60% efficiency at 450 MHz (offering a power output of

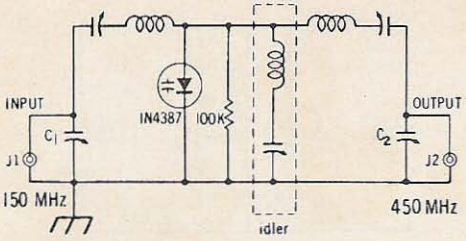


Fig. 3. Varactor tripler circuit.

18 watts with an input of 30 watts). The idler circuit is tuned to one harmonic below the output frequency. In this case the idler should be tuned to resonate at 300 MHz. The bias resistor is chosen as 100K so the circuit will operate linearly. The output circuit is then tuned to resonate at the desired output frequency (450 MHz). After alignment, it is a good idea to repeat the tuning procedure because there is almost always some interaction between stages.

Another use for the varactor is in the development of an FM signal. By rectifying a modulated signal and applying that fluctuating voltage to the terminals of a varactor, we could use the changing capacitance of the varactor to cause frequency deviation of an oscillator. Hence, the development of frequency modulation via the varactor. Also, by properly proportioning the fluctuating audio voltage going into the varactor with respect to the oscillator, either narrowband or wideband FM may be obtained, as shown in Fig. 4.

In the circuit of Fig. 4, a rectified audio voltage is introduced at the potentiometer which can be adjusted to allow the required frequency deviation whether it be wideband or narrowband. The charging and discharging of capacitor C_1 through resistor R_1 applies a fluctuating voltage on the anode of the varactor. This fluctuating voltage will cause the capacitance capabilities of the varactor to vary, thereby pulling the oscillator off its center frequency.

As mentioned earlier, the property of being able to vary the capacitance of a varactor by varying the input voltage enables it to do the work of a conventional variable capacitor. One great advantage as opposed to conventional tuning is miniaturization. A typical varactor for this type of service in most cases is about the size of a small signal diode (1N34, for example) and this is many times smaller than even

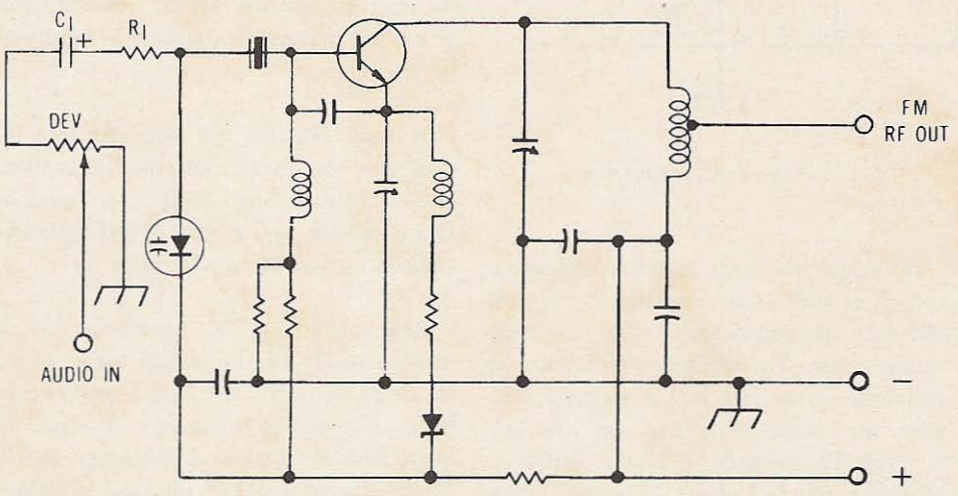


Fig. 4. Frequency Modulation using the varactor.

the smallest variable tuning capacitor. In cases where larger values of varactors are needed than is available, parallel operation is feasible. However, it must be kept in mind that both the minimum and the maximum capacitance capabilities are increased with parallel operation. Multistage tuning that at one time required a large ganged variable capacitor can now be controlled by a single small variable potentiometer by varying the dc control voltage to the varactor. The illustrations of Fig. 5 show a typical circuit using a varactor for tuning along with a circuit utilizing varactors for multistage tuning.

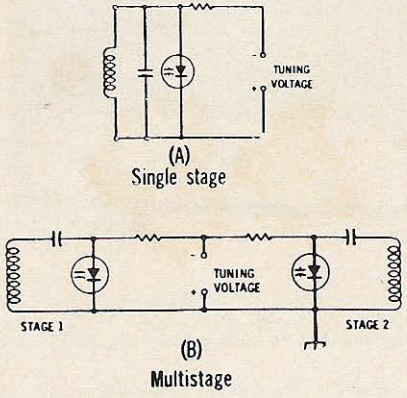


Fig. 5. Varactor tuning.

In the case of an FM receiver, a varactor can be utilized to regulate the amount of drift of the local oscillator by compensating for that drift and, in a sense, locking it on frequency. This type of circuit is commonly known as automatic frequency control or simply AFC.

What occurs in a typical AFC circuit (Fig. 6) is this: A correction voltage developed in the discriminator circuit is directed to a varactor through a filtering network. Any error in tuning will result in a voltage change at the discriminator and it is this change that is used to alter the capacitance of the varactor to compensate for that

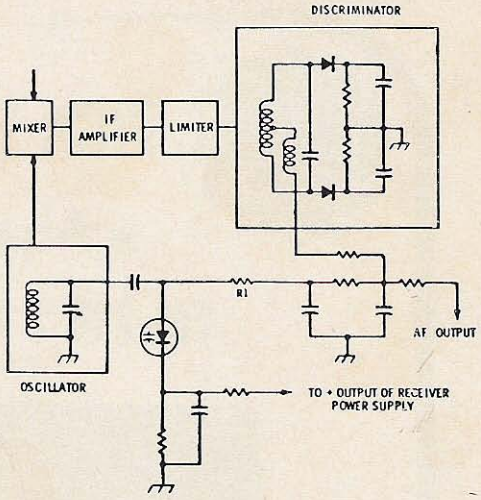


Fig. 6. Varactor afc circuit.

error. This changing capacitance is then used to complement the final tuning of the oscillator to lock it on frequency.

The possibilities of a varactor in communciations applications are almost limitless. Scan-tuning, a technique that once required many complicated circuits, is now simplified by a varactor: With scan-tuning, band sweeping is accomplished by applying a fluctuating voltage from a sawtooth oscillator. The sweeping rate is then predetermined by the frequency of that sawtooth oscillator.

This article just briefly illustrates how the varactor, a comparative newcomer to the field of semiconductors, opens the door to simplifying and improving many different types of electronic circuits. . . .Mengel■

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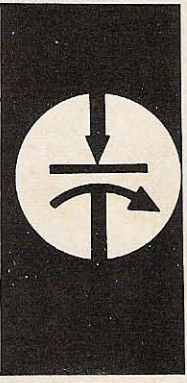

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- Transmitter: 5 watts (10w with AC-210 power booster)
- Microphone: High Z
- Deviation: Adjustable narrow or wide band with clipper filter also adjustable for optimum clipping lever

Receiver:
- Sensitivity: SINAD .5 uv for 12 db
- Quieting: 1 uv provides 20 db
- Squelch: Continuously adjustable
- Modulation Acceptance: FM wide band (narrow band available on special request)
- RF Circuitry: FET front end and duo conversion for minimum cross modulation and overload
- IF Frequency: 10.7 MHz and 455 KHz.
- Frequency Control: 3 channel transmit, 3 channel receive. (146.94 MHz furnished) Transmit and receive frequencies independent of each other
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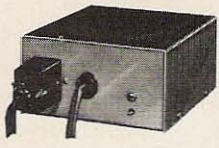

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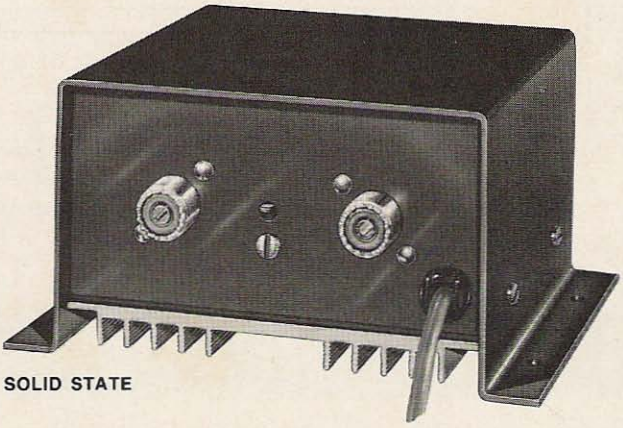

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SPECIFICATIONS:

- Input Voltage: 12v DC, negative ground only
- Power Input: 60 watts
- Power Output: 35 watts
- Frequency Range: 143 MHz to 149 MHz
- Operation: Class C
- Drive Requirements: 5½ watts required for 35 watts output (the PA-210 provides operating voltages to the FM-210 for high power operation)
- Antenna Requirements: 50 ohms unbalanced

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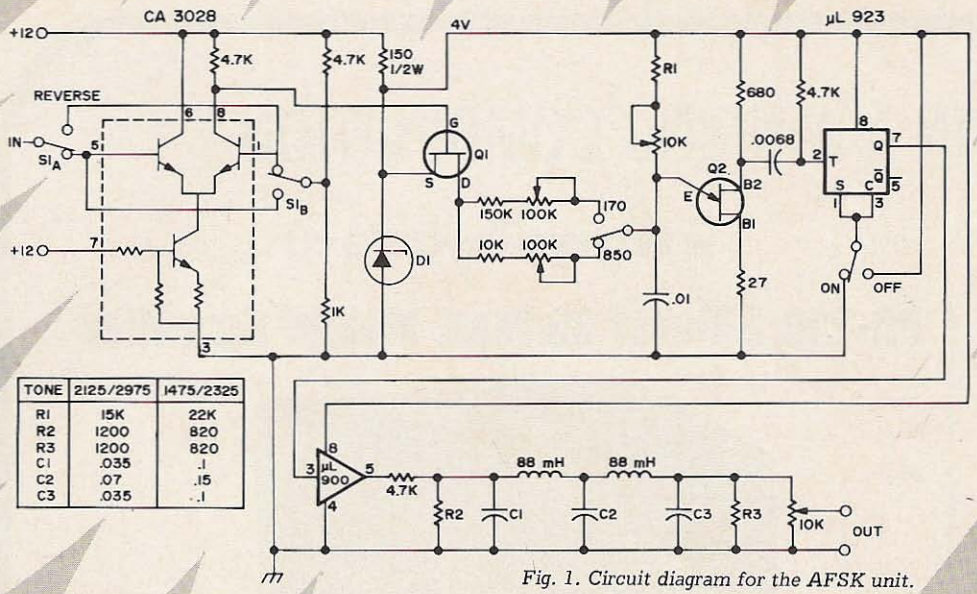

Fig. 1. Circuit diagram for the AFSK unit.

A clean AFSK unit

John Lovallo WB4FMP
619 Hayes Dr.
Lynchburg VA 24502

When it came time to put my new SSB transmitter on RTTY, it was apparent that using the microphone pick for AFSK input was the most desirable method. While there are dangers in this method concerning noncompliance with FCC regulations regarding purity of emission, it was decided that the advantages of being able to use the VOX circuits for switching and being able to transceive on RTTY would make this approach worthwhile. Since the transmitter uses a steep-skirted bandpass filter, it was felt that such a system could yield good results. Indeed, the method of CW generation is introduction of an audio tone into the audio stages.

After conducting a search of the available literature, the following list of desirable qualities for an AFSK circuit was made:

- Negligible harmonic generation
- Freedom from keying transients
- Ability to reverse shift
- Equal mark and space amplitude
- Wide and narrow shift capability
- Ability to use low and high frequency tones
- Easy to build and align

Of all the circuits examined, only that designed by K3NI0 and described by Irv-n Hoff[1] appeared to meet all of the first five criteria. Unfortunately, this design did not give information for using this unit on the low-frequency tones required by most of the transmitters that are adequate for this mode of FSK generation. The circuit is somewhat more complex to build than most of the AFSK units now in use, which may have discouraged its construction by many amateurs.

As a result of this analysis, I came up with a new circuit (Fig. 1). Construction may be simplified by the use of a printed-circuit board. The use of inexpensive integrated circuits further simplifies construction. Information is given for use with 2125/2975 and 1475/2325 Hz tone pairs. The latter tone pair was chosen as optimum from the

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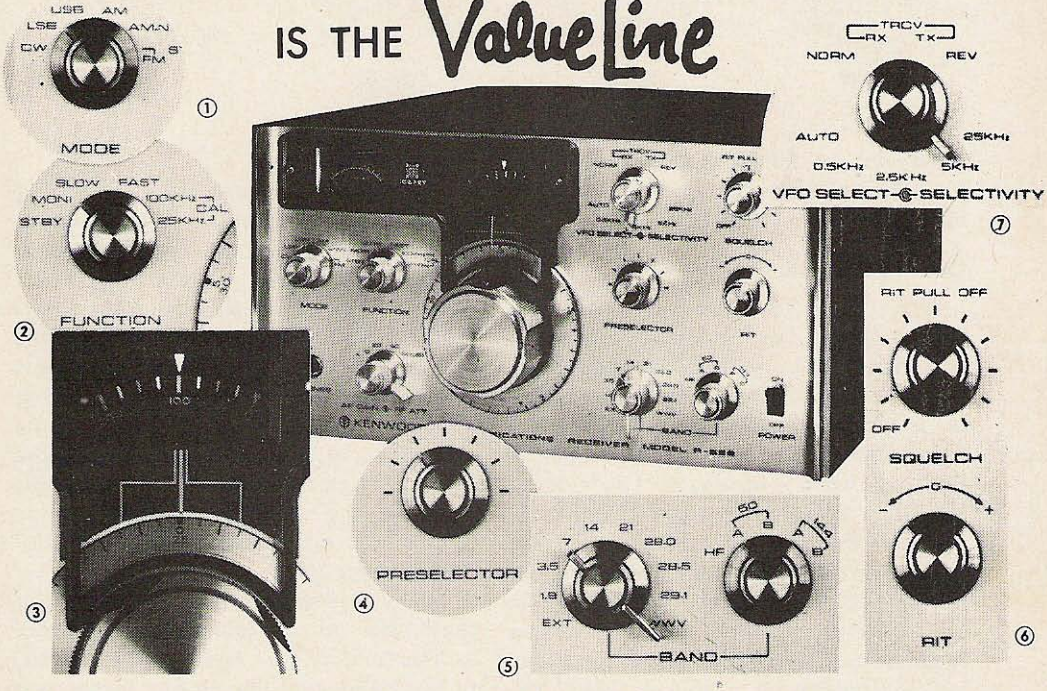

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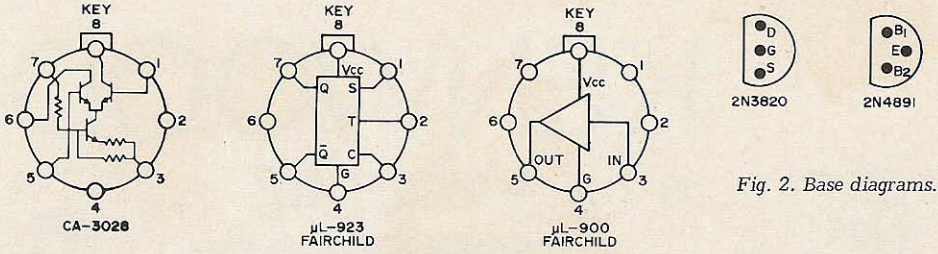

Fig. 2. Base diagrams.

standpoint of minimizing spurious signal generation in a transmitter with a 2.1 kHz bandpass filter.

Circuit Description

The basic scheme of frequency generation for this circuit is the same as that designed by K3NI0. A free-running unijunction transistor multivibrator is used as a frequency-shifted pulse generator running at twice the desired frequency. This pulse train is divided by two in an IC Flip-flop, forming a constant-amplitude square wave of the desired frequency. The square wave is then filtered in a five-pole Butterworth low-pass filter which suppresses all odd harmonics above the fundamental frequency (even harmonics are not present in a square wave). The frequency of the oscillator is shifted by switching an additional resistance from supply voltage to the emitter of the unijunction. This provides more charging current to the capacitor and results in a higher-frequency pulse train. The actual switching is done using a P-channel FET as a switch to achieve the very high *off* resistance necessary for easy adjustment of the shift. The FET is driven by a differential amplifier which senses the keying loop circuit. This diffamp is used as a current-switching discriminator and allows us to reverse shift very easily by interchanging the input leads. The switching threshold is approximately +2V at the input, which may be conveniently obtained from the TTY loop supply current passing through a series resistor.

The power supply (not described here) is merely a single-ended 12V supply. Regulation is not particularly critical, and the current drain is only 55 mA.

Construction

The AFSK unit, with the exception of power supply, frequency determining potentiometers, and input coupling circuit, is built on a plug-in printed-circuit board which should be available from the Harris Co.[2] Pay particular attention to align the key on the semiconductor components with the key on the circuit board and you can't go wrong. If you are not using the printed board, pay close attention to the basing diagrams given in Fig. 2. The 88 mH coils are the surplus telephone loading toroids and are readily available at very reasonable prices.[3]

Since reversing shift is not normally done after initial installation, the switch for this function may be omitted if desired. In my own unit, the plug-in socket was wired so that turning the board over in the socket reverses the shift.

Alignment

After applying power to the unit from a suitable source the *operate/standby* switch should be put to "operate." With the reversing switch in normal, the 25 kΩ potentiometer should be adjusted for the low tone. Next, apply approximately 4V to the input. A jumper from the cathode of the zener to the input will do. Now adjust the 100 kΩ potentiometers for the narrow and wide shift high tones. That's all there is to it!

Keying circuit

The keying circuit in use at my station is shown in Fig. 3. Many other schemes can be used; however, they should be examined to make sure that they will not place over 6V on the input of the differential amplifier. If in doubt, my own simple protection scheme is good insurance.

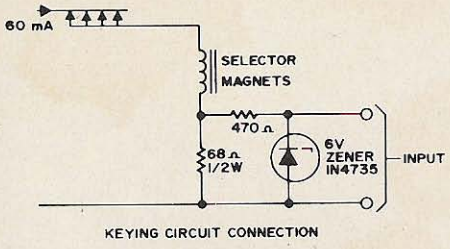

Fig. 3. Keying circuit connection.

Conclusions

This AFSK unit represents an advance over many other desigs which have been offered. Its freedom from keying transients and harmonic generation should help clean up some of the signals heard on the band presently. The presentation of a design for the lower tone pair should allow use with many transmitters without modification. Economy semiconductors and integrated circuits are used, and the cost of building the unit with all new parts should be about $10. Certainly a clean signal is worth that! If you like your circuits "ready printed," you can send a $2.50 check to American Photo Etch Co., Box 2627, South San Francisco CA 94080. If you'd rather do your own, check the board and component layouts in Figs. 4 and 5.

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2. Harris Company, 56 E. Main St., Torrington CT.

3. Elliot Buchanan Assoc., 1067 Mandana Blvd., Oakland CA.

. . .WB4FMP■

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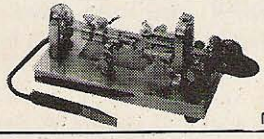

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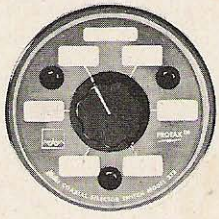

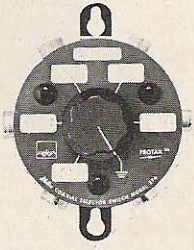

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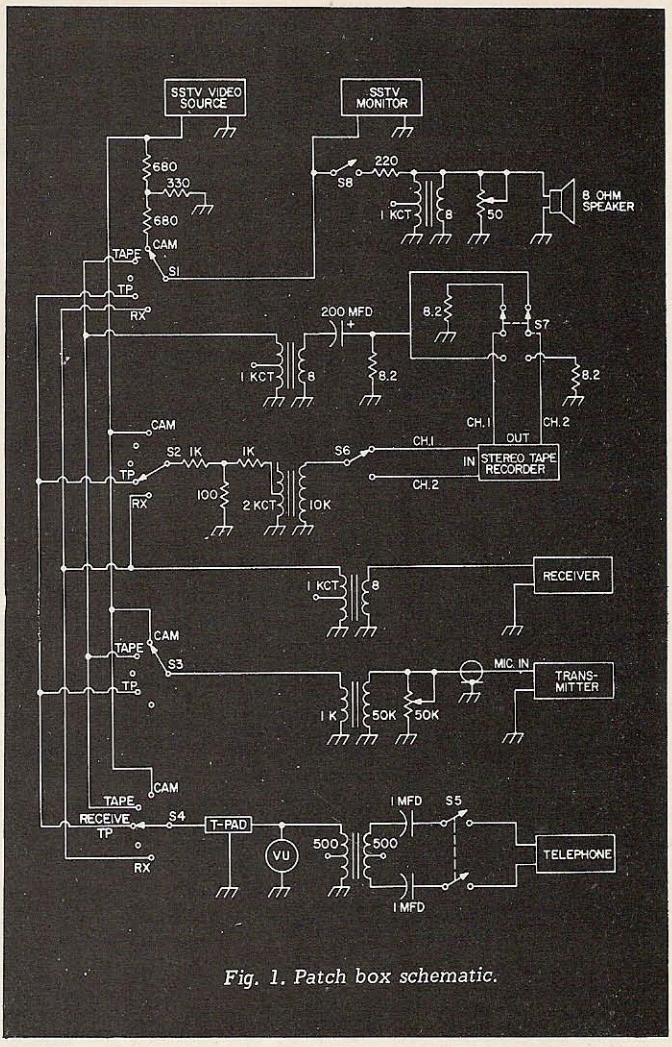

Fig. 1. Patch box schematic.

The subcarrier FM slow-scan television (SSTV) standard most widely adopted in the United States (Macdonald, 1961) permits SSTV equipment to be used with any device designed for the audio frequencies. Thus, a basic SSTV system consisting of a monitor (Macdonald, 1964; Cohen, 1967) and a video source (Vidicon camera: Macdonald, 1965; Taggart, 1968; Hutton 1969; Flying Spot Scanner [FSS]: Hutton 1967; Pattern generator: Hutton, 1969) can be used, and often is used, in conjunction with a communications receiver, transmitter, audio tape recorder, and telephone. With the possibility that six or more pieces of equipment may be involved in SSTV operations at a given station, a requirement exists for a versatile, efficient means of interconnecting the various equipment inputs and outputs. The slow-scan TV patch box described below is designed to provide this patching capability. While in principle similar to the SSTV switching network described by Taggart (1968), this patch box includes:

1. provisions for patching signals between a monitor, video source, communications receiver, transmitter, two-channel (stereo) tape recorder, and a telephone;
2. a phone patch and attendant meter for signal level monitoring;
3. inter-stage transformer coupling; and
4. background audio monitor.

General Comments

The patch box schematic is given in **Fig. 1**. The author's unit, built in a Bud "Portacab" (Model WA-1540) is shown in **Fig. 2**. For efficient interstage coupling, transformers are used between the major system elements. The input/output impedances characterizing equipment at the author's installation are shown in **Table I**, together with the transformers employed.

Transformers chosen represent a compromise between the characteristic impedances of the various pieces of equipment, and the design factors of the high-quality, inexpensive line of Argonne transformers.

Wiring is noncritical, though shielded audio cable should be used for the lead to the transmitter's microphone jack. All switches, gain controls, and the VU meter are mounted on the front panel; the transformers, fixed-value T-pads, and speaker are mounted on the top of the subchassis (Bud, AC-402; see **Fig. 2**). All input/output leads (except those for the telephone) terminate in jacks which are mounted on the rear panel of the subchassis. The RCA phono jack was chosen as the patch box standard, not only for its small size, but also for its widespread application in audio equipment. Bypass capacitors are recommended for each input and output jack; these capacitors (.001 to .01 μFd) should be mounted at the jacks. with leads kept as short as possible. In cases where severe rf feedback is encountered, rf chokes may also have to be installed in the input/output leads.

The patch box is completely passive. Thus, no power source is required.

Table I. Characteristic impedances and transformers employed.

EQUIPMENT	INPUT IMPEDANCE	OUTPUT IMPEDANCE	ARGONNE TRANSFORMER
Video source	----------	1K	----------
Monitor	600	----------	----------
Tape recorder			
Channel 1	10K	8	IN: AR-109 (10K: 2K CT)
Channel 2	10K	8	OUT: AR-137 (8:1K CT)
Telephone	600	600	AR-162 (500 CT:500 CT)
Receiver	----------	8	AR-137
Transmitter	50K	----------	AR-129 (50K: 1K)
Background monitor	8	----------	AR-137

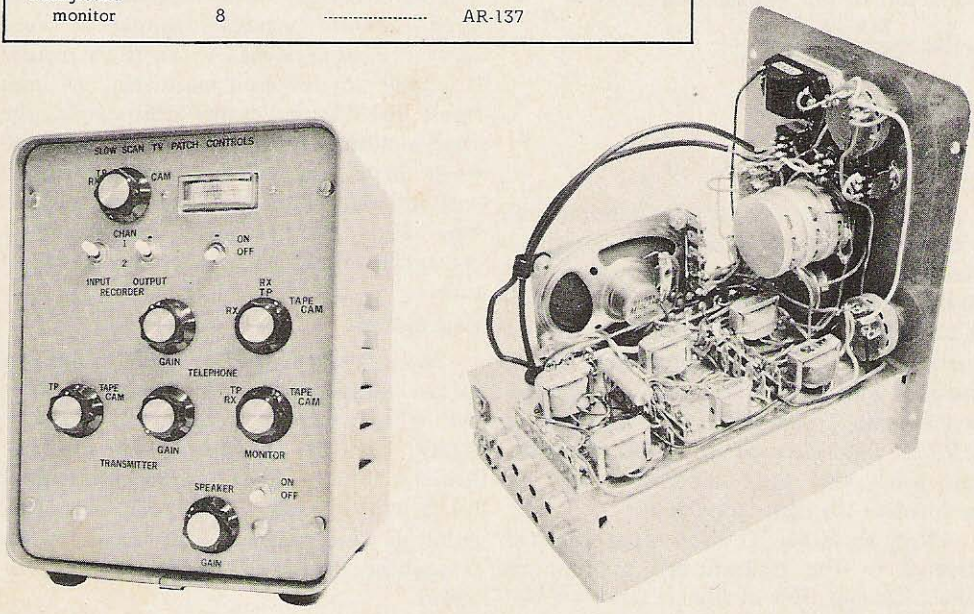

Fig. 2. Front and interior views of patch box. Extra RCA phono jacks are provided on the rear panel for multiple outputs (if desired).

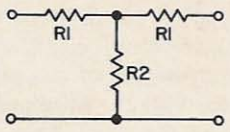

Fig. 3. Generalized diagram — T-pad attenuator.

Circuit Details

Though the logic behind the design and operation of the patch box is largely self-evident, a number of comments are warranted.

The output of the author's vidicon SSTV camera is slightly over 3 volts RMS. This is considerably larger than that required to drive the monitor's FET input amplifier. Thus, a T-pad attenuator (**Fig. 3**) is inserted between the camera and monitor, here designed to reduce the input voltage to the monitor by a factor of 6. To protect the tape recorder's input circuits, all recorder inputs are attenuated by a factor of 20. As T-pads other than those used here may be required, design criteria for the T-pads are given below:

Let $k = E_{in}/E_{out}$, and define Z to be the characteristic line impedance. Then:

$$R_1 = \frac{Z(k-1)}{(k+1)}$$

$$R_2 = \frac{2Zk}{(k^2-1)}$$

Phone patches used in SSTV communications rarely need be more complicated than that shown in **Fig. 1**. Two 1 μFd high-quality (Mylar) capacitors provide for dc isolation and line balance. The transformer provides a single-ended line to the patch box, and a balanced line to the telephone. A conventional audio T-pad (IRC TP500A, Mallory T500 or T600) is used to set the telephone line level, this level monitored on the inexpensive VU meter provided.

As shown in **Fig. 1**, SSTV signals are fed directly to the transmitter's microphone input. Examination of **Fig. 2**, however, will show that panel space is available (lower left) for a switch and microphone jack. Installation of the switch and jack as shown in **Fig. 4** further enhances the versatility of the patch box, allowing the operator to choose easily between video and live oral signals.

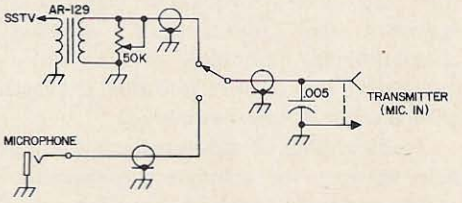

Fig. 4. Alternate SSTV-microphone input circuit. The switch and microphone jack may be mounted on the lower left portion of the front panel.

To protect the tape recorder's output transistors, an 8.2 ohm resistor is automatically switched into the unused channel's output. Additional protection of the tape recorder's output circuitry is assured by using the minimum playback gain required. Subcarrier FM SSTV is a constant-level mode, and unless playback gain is minimized, output transistors and transformers will overheat and be destroyed. To protect the tape recorder during SSTV recording sessions, place the recorder selector switch in the PAUSE or RECORD position only when you are about to record. Further, the individual recorded segments should be kept short. For practical reasons, an SSTV picture is usually not repeated more than 10 times (most SSTV'ers get bored after viewing the same picture twice). Thus, with the 8-second frame period employed, a typical recorded segment should be less than 1½ minutes long. Most tape recorders will handle a constant-level input signal for this period of time.

Conclusions

The patch box described has been in use at the author's station for over two years. During that period, it has been found to greatly facilitate tape record and playback sessions. Further, it has proven indispensible for local SSTV operations where the camera, monitor, tape recorder, and telephone are frequently employed in various combinations.

Those desiring further information on slow-scan television are referred to the liter-

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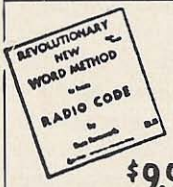

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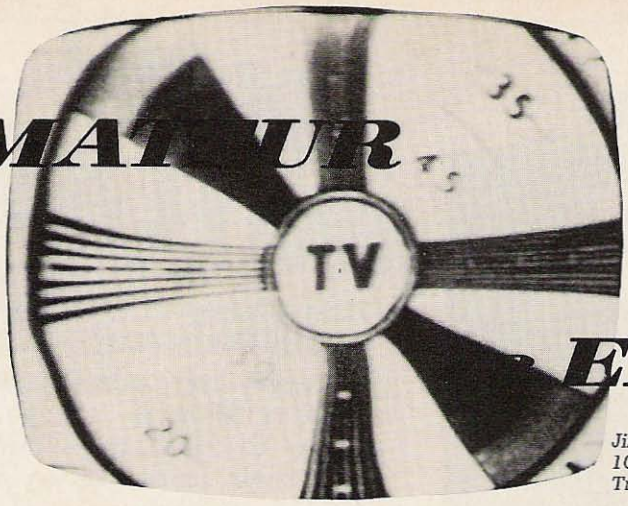

Jim Zimskind K2OJL
108 Kensington Avenue
Trenton NJ

CQ, CQ, CQ, this is K3FEN, Richboro, Pennsylvania, beaming northeast, calling CQ, monitoring 439.25 FM and by for a call.

K3FEN, this is K2OJL – pix looks good, Taylor, go ahead.

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(1) Lots of enthusiasm.

(2) Lots of cold beer.

This article is intended to stimulate interest and subsequent operation of this beautiful mode by those who already have thought about it and were not really aware of new stations on the air.

I could discuss how much pleasure we have all derived from looking at one another as well as talking to one another. But I hope you will discover this for yourself. We have 18 stations, an outgrowth of four original anchormen who coerced, enticed, and frankly used bigger hammers on the heads of the skeptics ...who otherwise would be calling their heads off trying to raise Aunt Zelda on the five-meter band.

Well, I hope I have elicited your interest, because now we come to the main purpose of this article, which will be my attempt to illustrate the most economically feasible way to insure your success on A5.

After a year or so of playing with various combinations of antennas, preamps, converters, receivers, cameras, transmitters, video modulators, rf amplifiers, I have arrived at what is a simple and effective station setup, easily afforded by the average ham, and easily put together into a working system. Let's divide the station into three basic systems: receiver, transmitter, and antenna.

Antennas

Good reliable reception and transmission at 440 MHz requires a high-gain, wide-bandwidth antenna. Most of the fellows are using the new Cushcraft 20-element DX array in combinations of

20, 40, or 80 elements at heights of 50–80 feet, fed with low-loss coax which matches the antenna impedance of 50Ω as well as the output of a 50Ω transmitter. Large-diameter "hardline" (available from Deane Kidd, K7ZIR, in Beaverton, Oregon, in 55 ft coils at a cost of $20) exhibits a loss of less than 0.5 dB at 450 MHz. It is waterproof, conforms to any structure, can be bent and filled with bottled gas to eliminate moisture. RG-9 is also good at these frequencies, slightly better than ordinary RG-8, which will exhibit approximately 5 dB loss per 100 ft.

As the video portion of the signal must be 10 dB above the audio, for best results, I urge that you obtain the best coax you can, terminating preferably with Type N or BNC fittings at every point in the system. Though almost any antenna will work, I recommend the collinear because of its reliable gain and bandwidth. Remembering Sam Harris' adage, "If your antenna didn't fall down last winter, it wasn't big enough," I suggest that the bigger and the higher, the better.

Transmitters

Probably the easiest way to get on TV is by converting a 450 MHz commercial FM transceiver, such as an RCA CMU-10 or 15, using 5894s in the final, a GE "Pre-Prog," or a Motorola T-44 (both with 2C39s). These units are available complete with receiver, transmitter, crystal ovens, and dc power supply for around $35.

Tuning the transmitter is not much more complicated than obtaining a crystal for the frequency you desire to work. Here in the tri-state area of New Jersey, New York, and Pennsylvania, we are using 439.25 MHz. It is a reasonably simple matter to adjust the various stages in the transmitter with the help of a VOM, which will plug right into existing test points. The tuneup procedure involves about a half-hour of time.

Once you have obtained approximately 15W of rf output from the strip, all that remains to be done – and don't let it scare you – is building the video modulator. W6QUI has designed an excellent two-transistor video modulator which can be built at a cost of approximately $10, including a printed circuit board available from Tom O'Hara (W6ORG) at a cost of $3.50. It uses only a handful of solid-state components and has been found to be capable of reliably modulating the 2C39 final. Simply run a lead (the shorter the better) from the output of the video modulator to the grid of the final, and apply 100V dc (regulated) to the video modulator.

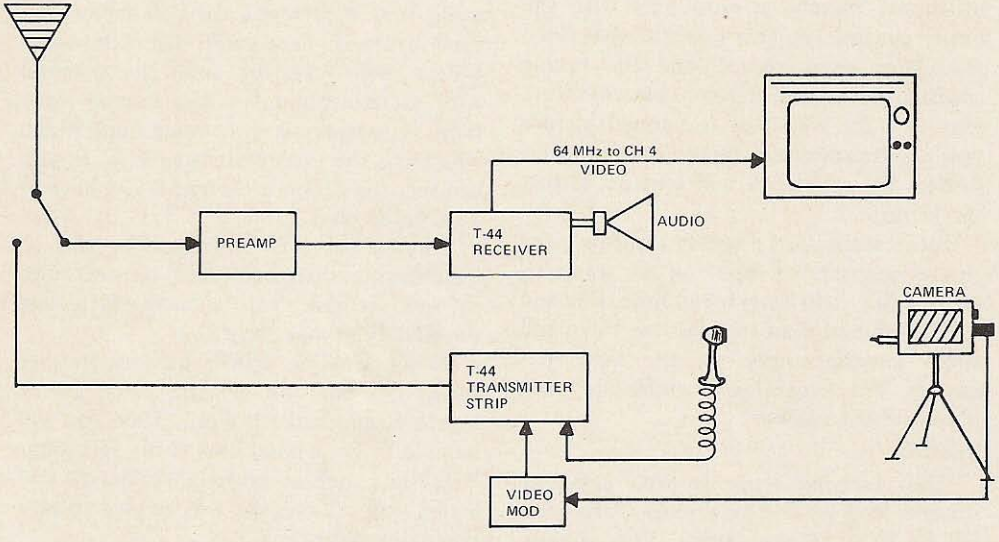
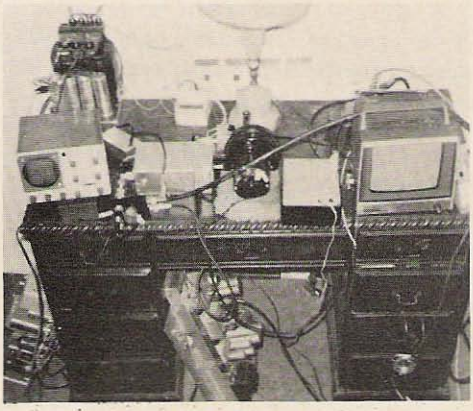


Fig. 1. This block diagram shows the true simplicity of a typical ATV station.



Messy and mickey mouse, but when all the jumper wires are connected and the zip-cord extensions are plugged in, it really works.

All that remains to complete the transmitting side of the stage is a camera. TV cameras are available from many sources and range in price from approximately $50 for a used Jap camera, to $300 for a new one, and $100 to $1000 for a good-quality U.S.-made type. All of the modern small transistor cameras produce enough peak-to-peak voltage to drive the modulator (about 2V).

After you have the system on the air and are monitoring, it's a good idea to sample some of the rf through a video detector, coupled to either a scope or a video monitor so that you can watch the off-the-air picture as you play with the beam control on the camera, the video modulator gain control, and the tuning controls on the transmitter. This will insure that you are watching the actual picture you are transmitting, rather than an overloaded TV set which will tend to distort the picture.

Incidentally, just connect a carbon mike to the microphone input on the transmitter, as the strip serves for both FM and AM, the function of transmitting video and audio simultaneously on the same frequency. The separation of audio and video is done at the receiver.

Receiver

The receiving setup is even easier to organize and get working, particularly with GE or RCA receiver strips. Very simply, it's just a question of obtaining a crystal at the proper frequency, plugging it into the crystal oven, applying voltage, and tuning the various stages for best received signal, or by letting anyone with a frequency meter and a signal generator tweak each stage for maximum. *Ed. Note: T-44s can be a pain, though. Even though they're probably the best performance-wise, you may have a tough time getting the right crystal. Some T-44s use a 10 MHz crystal, others use a 30 MHz rock. And the actual crystal frequency will depend on the frequency of the second oscillator, which varies from unit to unit.*

A nice feature of the Motorola is that its receiver strips have an i-f output at 64 MHz, and through a coupling capacitor and with a small piece of coax (72Ω) you can pump this signal into channel 4 of any TV set and get good resolution and gain. A balun at the TV set antenna terminals will transform the unbalanced 75Ω up to 300Ω balanced, to match the TV tuner. This system will allow you to use the squelch already on the receiver strip so that with your TV set off, you can always hear an ATV'er break the receiver.

Incidentally, you can use the transmit–receive relay already incorporated in the transmitter strip, for one-switch operation or push-to-talk, as you like.

So, there it is, and inexpensive, reliable amateur TV system that many fellows are using, and with which they are having the time of their ham radio lives. My own future plans call for color transmission with stereo sound and the use of video tape. A repeater is now being built which will serve the three-state area – so, as you can see, the action is there. All you have to do is get in on it.

Any of the ATV'ers would be glad to demonstrate their equipment in operation as well as give you a hand with any problems you may incur.

Don't let this article be just another thing. Go out and get the parts, put it together, and make it work. Then you will be able to get a good look at my secretary, WB2PQZ. She's an avid ATV'er herself and a real doll . . .and she will be glad to give you a demonstration.

. . . K2OJL ■

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Selectivity	6DB Down ± 16KC 50DB Down ± 32KC
Audio Output (3-4 Ω Speaker)	3 Watts 10% Distortion 5 Watts Maximum
Channels	6 Crystal controlled with provision for adding an additional 6 channels
I.F. Frequencies	10.7 MHz & 455KHz

TRANSMITTER

The HR-2 transmitter uses phase modulation for the ultimate in carrier stability. Built in SWR load mismatch circuitry provides protection against open and shorted antenna conditions.

Frequency Range	144-148 MHz
Power Output	10 Watts (min.) @ 13.6 VDC
Modulation	Phase Modulation with automatic deviation limiting
Deviation	Automatic Limiting with internal adjustments from 0-15KC deviation
Microphone	Plug-in, hand held, high Z Ceramic supplied
Channels	6 Crystal controlled with individual trimmer capacitors for Frequency netting

GENERAL

Power Requirements	13.6 Volts (nominal)
Receive (Squelched)	180 MA.
Receive (Max. audio output)	800 MA.
Transmit	2.5 Amps (max.)

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A Tuning Indicator for RTTY and FAX

Don Kadish W1OER
135 Barbara Road
Waltham MA 02154

The tuning indicator shown in Fig. 1 operates directly from the receivers audio output. It can be used "as is" if audio is taken from the high impedance phone output of the receiver. If a low-impedance speaker output is used then an 8Ω/10 kΩ step-up transformer will be required to insure an adequate signal amplitude at the grid of V1.

An inexpensive two-shadow "tuning eye" tube is used. One plate tunes in mark for RTTY or *white* in the case of FAX. The other plate tunes in space for RTTY or *black* for the other mode. Two sets of filters are used using either 88 mH toroids or 100 mH television-type inductors. The FAX filters are resonant at 2300 Hz (white) and 1500 Hz (black) respectively. RTTY filters are tuned to 2125 and 2975 Hz. An additional 2295 Hz filter ins included for tuning in narrow-shift RTTY.

Filter tuning is most critical of course and should be within a few hertz. You can either purchase the tuned filters from hams engaged in the business or tune your own if equipment is available. If you decide to tune the filters, a frequency counter, stable audio oscillator, and high-impedance electronic voltmeter with good frequency response is required. The equipment setup is shown in Fig. 2. 1 MΩ resistor is used between the oscillator and the tuned circuit under test to insure that a high Q is maintained.

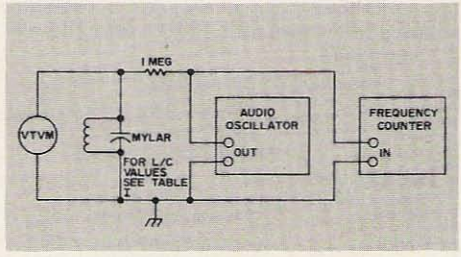


Fig. 1. Double-eye tuning indicator.

Most audio oscillators have a fairly low-impedance output (on the order of 500 Ω) which would decrease the Q of the tuned circuit. As a result, the tuning would be broad. The capacitor (Fig. 2) should be a high-grade Mylar type. Tolerance of the capacitor is not critical since tuning will depend on adding or subtracting turns

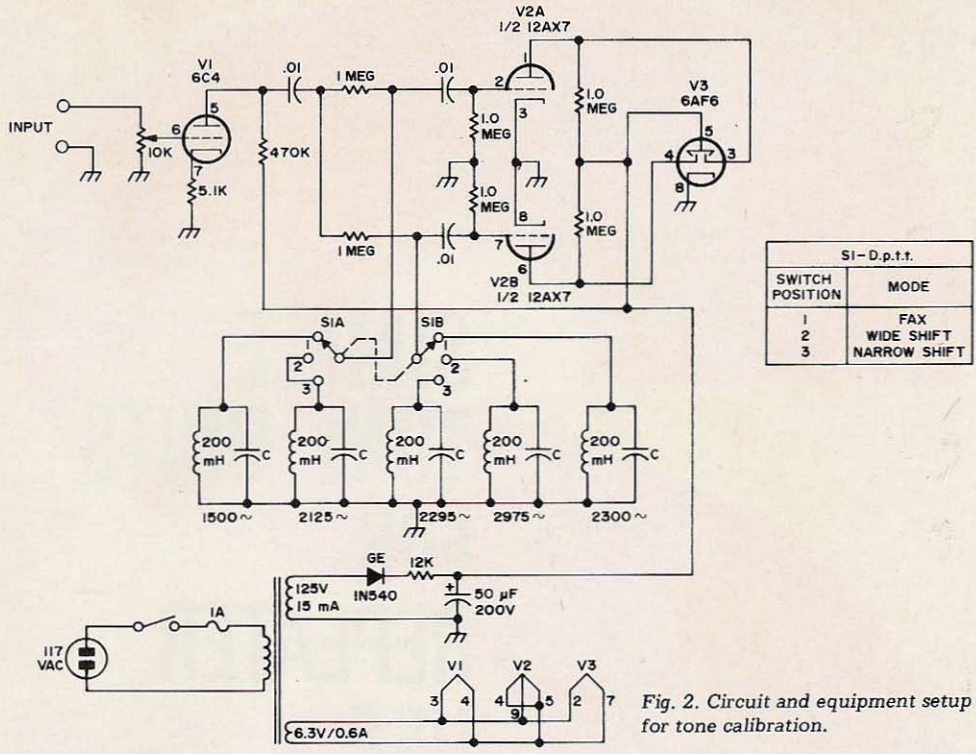


Fig. 2. Circuit and equipment setup for tone calibration.

from the inductor or varying the tuning slug if a 200 mH TV width control is used.

Table I shows capacitor values for 88 and 200 mH inductors. Set the audio oscillator to the desired filter frequency with the aid of the frequency counter. Vary the oscillator amplitude until the voltmeter (ac scale) indicates an arbitrary voltage. A low-amplitude output from the oscillator is preferred to minimize the possibility of saturating the inductor. Tune the filter for a maximum indication on the voltmeter. This insures parallel resonance.

Because of the high Q of 88mH toroids it might be necessary to swamp it with a low-value resistor, allowing slightly broader tuning. TV width coils if used, are broad enough, making the resistor unnecessary. However, if 88 mH toroids are used, place a 150 Ω resistor in a series with one leg of each inductor. If the filters are too sharp, stations with shifts slightly divorced from the standard will be out of the bandpass and not received. The described technique can also be used for tuning RTTY demodulator filters.

When an RTTY station is received and the receiver is tuned to mark (2975 Hz), one of the tuning-eye shadows will close. A space signal will close the other shadow. The white or black transmission from FAX (2300 and 1500 Hz) will close its respective shadow. Shadow width is controlled by the 10 kΩ potentiometer which varies the grid drive at V1.

Table I.

Frequency, Hz	L, mH	C, μF
1500	88	.125
2125	88	.068
2295	88	.047
2300	88	.047
2975	88	.033
1500	200	.047
2125	200	.022
2295	200	.022
2300	200	.022
2975	200	.015

It will be found that the indicator is an adjunct to any RTTY or FAX demodulator. . . . W1OER■

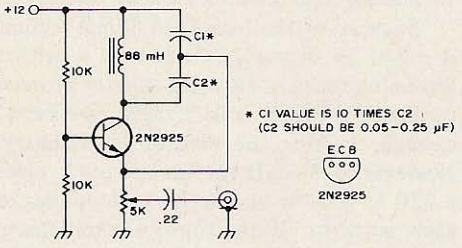
SIMPLE TONE UNITS FOR REPEATER USE

Bob Kertesz VE2BZK
7794 Kildare Rd.
Cote St. Luc 268, Quebec

Being quite active on two meter FM, I've recently felt a need to add some versatility to my setup by installing a remote control system from my mobile to base station. The circuits I came up with are extremely stable and reliable through wide temperature and voltage variations. The encoder and decoder are equally usable for subcontrol of conventional tone-controlled in-band repeaters.

Encoder

The encoder is a standard LC feedback type, and is as stable and accurate as the quality of the components used in the collector circuit. I used a standard 88 mH toroid for the inductance, and then figured out C_1 and C_2 from $f=1/(2\pi\sqrt{LC})$ where f is frequency in hertz, L is inductance in henrys, and C is capacitance in farads. The capacitors are in a ratio of 1:1 to get a high Q, so after arriving at $10(C1)_2/11(C1)=C$



cont. on page 38

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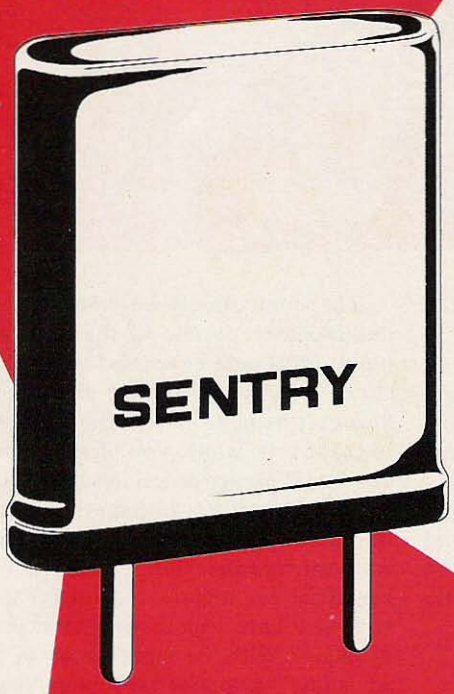

Somewhere along the line, in virtually every ham repeater in the world, you'll find a couple of Sentry crystals.

Repeater owners and FM "old-timers" don't take chances with frequency—they can't afford to. A lot of repeater users depend on a receiver to be on frequency, rock stable...in the dead of winter or the middle of July. The repeater crowd took a tip from the commercial "pros" a long time ago—and went the Sentry Route.

That's one of the reasons you can depend on your local repeater to be there (precisely there) when you're ready to use it. FM'ers use the repeater output as a frequency standard. And for accuracy, crystals by Sentry are THE standard.

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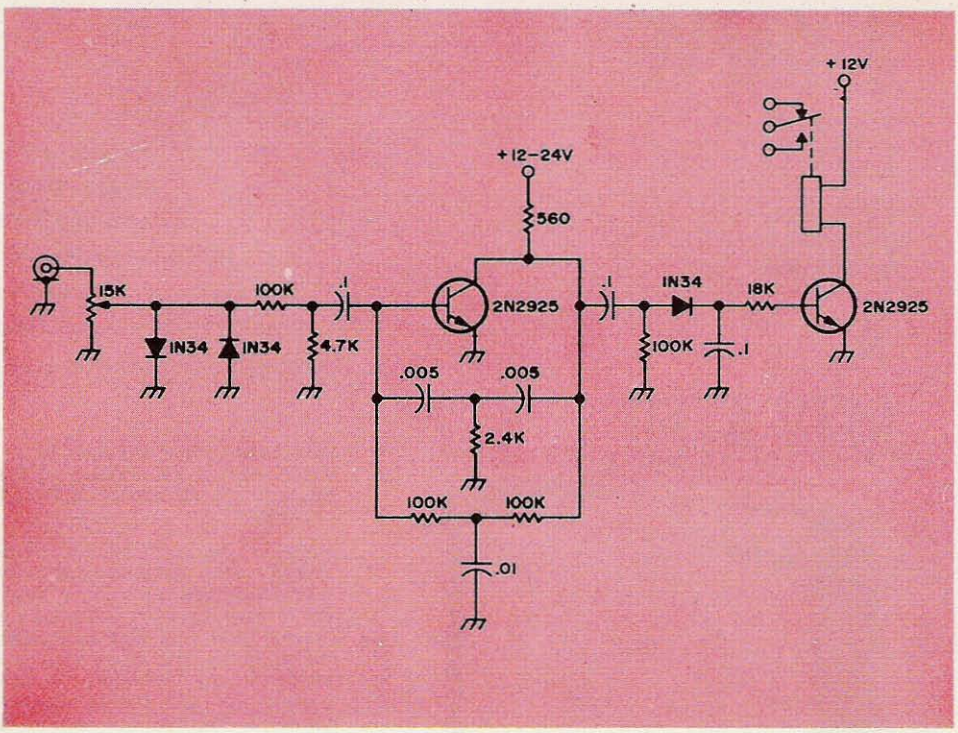


to get the value of C1, then multiply the result by 10 to determine the value of C2. For those who are mathematically lazy, 88 mH, 2 μF and 0.22 μF will give you approximately 1000 Hz. Use at least 10% mica capacitors for C_1 and C_2; otherwise, you will have stability problems. The transistor can be just about any general purpose NPN you have around. The output should be connected to your mike input, and the control adjusted to give about 5–10 kHz deviation.

Decoder

The decoder is a twin-tee circuit followed by a dc amplifier. The input level control can be brought down to give you a bandwidth as narrow as ±30 Hz! The two input diodes clip the incoming signal to a maximum value of 0.2V peak to peak; they can be any general-purpose germaniums.

The output of the decoder is rectified and fed to a standard dc amplifier; the relay in the collector of Q_2 is the one I had in my junkbox, so you might have to experiment with the value of R_5; the relay should close at about 6V and 6–10 mA.

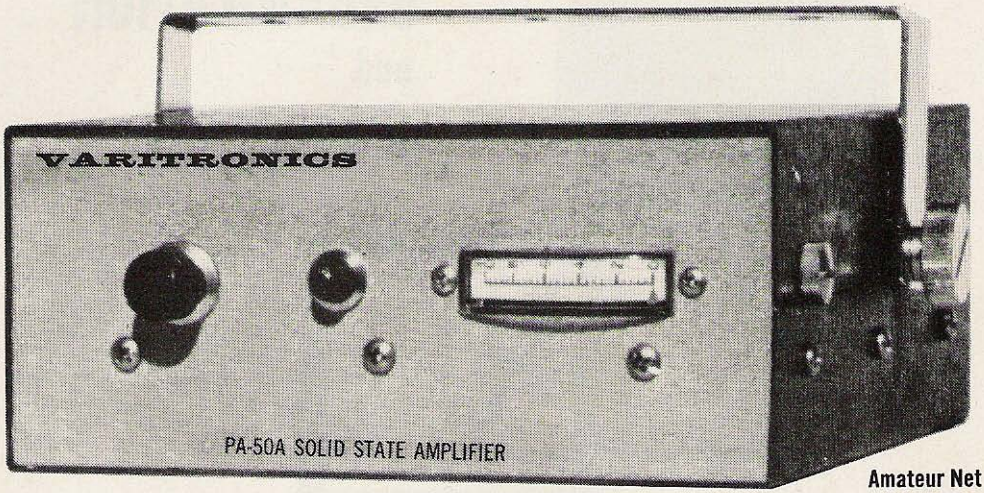
The input should be connected to the discriminator output of the receiver. The input pot should be set up so that the relay closes reliably every time the encoder is keyed; it helps to have a friend stay home to adjust it while you drive around. A 30–50 μF capacitor can be connected after the diode to give a turn-on time delay of 3 to 5 seconds; this will not be applicable to standard repeaters, but it could prove quite beneficial for remote control for those of you who have friends with strange senses of humor. With the capacitor in the circuit, an audio generator sweeping your frequency will not trip the decoder.

A heavy duty relay must be connected at the output, since the contacts on a sensitive relay are rated at only a couple of watts; a ratchet relay can also be used for latching on–off operation.

One final note: If you are going to use the system through an open repeater, be discreet. It is very annoying for people monitoring the frequency to hear tone bursts coming through; and finally, be sure to ID each time you use the unit.

...VE2BZK

Here's The Mobile FM AFTERBURNER



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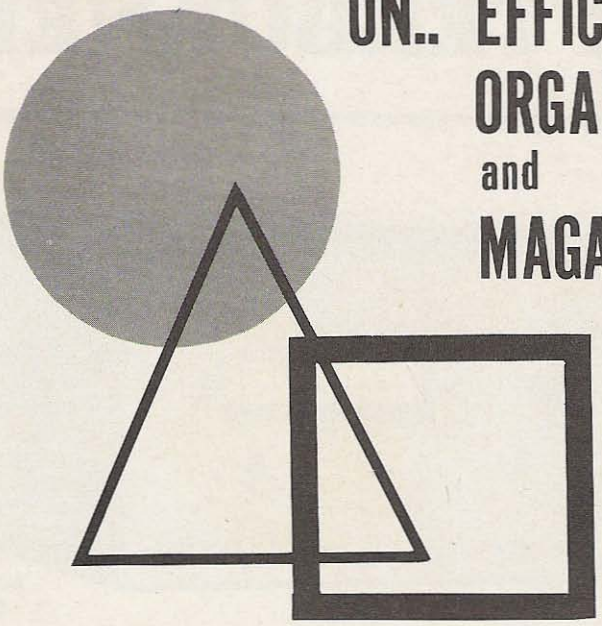

ON.. EFFICIENCY ORGANIZATION and MAGAZINES

Terry F. Ritter WA3BKC
8108 Bandera Road
San Antonio TX 78288

Contrary to popular belief, the most efficient method of organization is no organization whatsoever. In the case of a personal magazine collection, if you could *remember* the precise location of every article you have accumulated, you would never waste time hunting for a particular schematic, or putting the copy back in its "proper place." Since most of us do not have perfect memories, some organization is necessary to find the information we need in the mess we accumulate. The important thing to remember is: the more organized (and complicated) a system is, the less efficient it will be.

Indexes are remarkably inefficient devices for using information. A typical index assigns each article an individual position *and* locating file card. To use the index as efficiently as possible, one must keep both the magazines and the file cards in order. Additionally, when one is interested in information on a single topic, there is generally a separate magazine to find for each article, and a page to mark so one can refer back to it. Many of these articles will be useless and the magazines must all be replaced in order when the project is complete, or if the library is to be used again.

The method I use requires a minimum of organization as well as the wholesale destruction of the magazines in order to separate the individual articles. For those of us who enjoy collecting the complete set of magazines, this thought is like being against apple pie, motherhood, and The American Way. Nevertheless, *information you cannot find is useless*, so if you want to keep your magazines intact, I suggest you start in on your first thousand file cards, while the rest read on.

All pages of each important article must be removed from the magazine and stapled together. Each article should be marked on the top of the first page with filing subject (and magazine and date, if not printed in the article itself). All articles of the same subject are placed in a manila file folder which is filed alphabetically according to subject. The topics should be carefully chosen for their ideas, or underlying principles rather than their English names. For example, in one file labeled "mixers" I

keep articles on rf mixers, rf converters, AM modulators and demodulators, and other related devices. Af mixers are filed in my "hi-fi stereo" folder, and other systems of modulation are also filed separately. Those articles which are redundant or not worth keeping are discarded with the advertising, but make *sure* to keep everything you could ever possibly want. The volume of the information will be reduced at least by half, and probably more.

Occasionally an article is important in more than one area, so a note must be placed in one file that the article exists in another file, or (wonder of wonders) a duplicate made. Often, articles destined for different files contain a common page. These could be handled in several ways, but I hate to separate the pages of any article, so I bind these articles together, marking the topics of interior article(s) on the first page. Then the whole thing is filed under the subject of the most important article, using notes again where necessary. It is important that the system be kept manageable; when a folder fills up, it is time to discard some useless articles in the folder, or start a new subdivision of information.

This system pays for itself in the blinding speed with which one can find the details of a particular idea or design (even if you have forgotten where and when you read it), but there is more. All articles in similar fields are filed together, which is a tremendous advantage; if you want to build a converter, all important articles on converters are in one place. In one folder might be schematics of the most recent UHF converters, old VLF converters, as well as articles on conversion theory and design.

The disadvantage of the system lies in not being able to identify a specific magazine *per se*. This would be a major disadvantage to a library with many published indexes at their disposal, but for the individual who wants to *use* the information, the disadvantage is mostly imaginary. If the article is important, it will be in the proper file.

. . . WA3BKC ■

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220 MHz converter for FM POCKET RECEIVERS

Bill Hoisington K1CLL
Far Over Farm
Peterborough NH 03458

This article describes a low cost, two-transistor converter for use on the 220 MHz band, using any of the "police band" FM receivers that cover 146 to 180 MHz.

The availability of these pocket receivers, made by the Nagasaki Hardware Co., in the Not-So-Far-East-Now, was highlighted by K9STH in 73 Magazine, July 1970, page 44. A recent proposal to open up 220 MHz for no-code hobbyists prompted the building of a foundation converter as an almost instant means of seeing what could be done today with low-cost solid-state 220 MHz rigs. The Allied-Radio Shack Model A-2587 was used as the i-f, discriminator, and af, on about 170 MHz. This is the output frequency of the converter being described when using a 50 MHz crystal in the oscillator.

The A-2587 receiver uses a miniature *telephone* jack for the 50Ω antenna connection, but as long as it works, who is to say no? The insertion of this "antenna plug" into the antenna jack on the receiver also cuts off the extendable antenna very nicely.

After removing the telephone plug from one of those little plastic-wrapped white earphones that always accompany a Jap receiver, I converted it to an "RCA phono" adapter, making up the 170 MHz connection between the converter and the receiver.

Figure 1 shows the converter circuit using a Motorola HEP 56 transistor, good for 750 MHz use, as the mixer, and a HEP 55 for the 50 MHz oscillator.

No attempt to achieve low-loss high efficiency was made, because the later

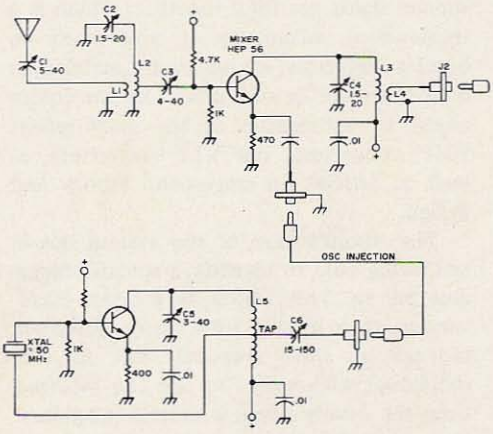

Fig. 1. Schematic, 220 to 170 MHz FM converter.

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installation of one or more low-noise figure rf stages is assumed.

At any VHF shack with a crystal within the 48 to 54 MHz range on hand, this unit can be assembled, wired, and tested easily in a day. The only thing to watch for, as always with an i-f near the signal frequency, is oscillator harmonics getting into the front end. The third harmonic at 150 MHz is pretty loud when you do tune across it (which you do *not* need to do, by the way). This harmonic can be dropped 20 to 30 dB by use of a series 50 MHz filter in the oscillator injection line, but was not found necessary here.

A small minibox will contain all the parts for this converter if you want to make a permanent unit out of it. It can also be made to fit flat on the back of the A-2587 receiver case if you want.

Generous use was made of Arco trimmers, and hand-wound coils did the rest, with nothing critical showing up, except that emitter oscillator injection was a *must*. Base injection at 50 MHz into a 220 MHz mixer did not work well at all.

A signal generator, 170 MHz tuned circuit (see Fig. 2), diode detector, and voltmeter were used to tune up the circuits and adjust the couplings. If you try and use the receiver as the i-f while doing this, you may succeed, but I find that the sensitivity tends to mask the desired results. Suit yourself on that. When you get a good solid dc signal out of the diode tuned to 170 MHz your converter and i-f output circuit are really working.

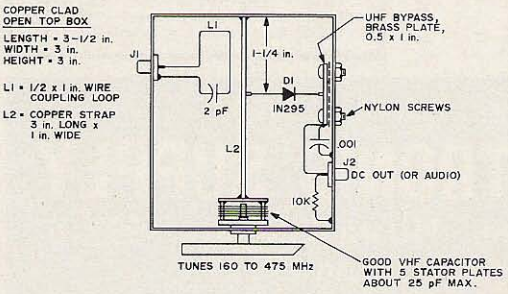

Fig. 2.

For new readers the 170 MHz diode detector is shown in Fig. 2. It also tunes up to 450 MHz, and will go down to 144 as well with slightly smaller dimensions and a 35 or 50 pF capacitor, thus covering three amateur bands.

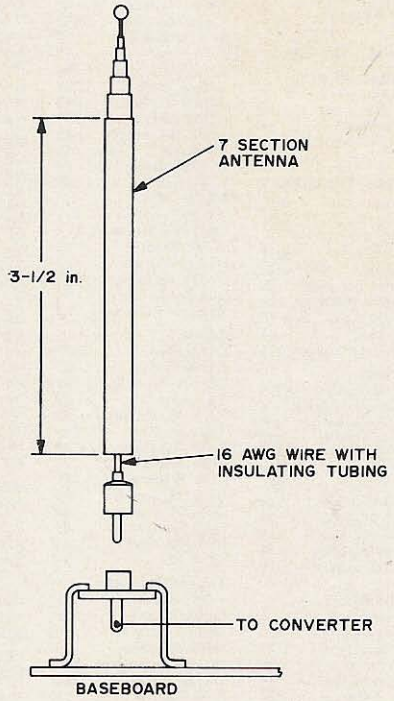

Fig. 3. 220 MHz breadboard antenna.

Coils for all schematics are listed in the following chart:

Coil	Wire No.	No. of turns	Length of coil	Diam. of coil	Position
L1	22 insul	2	¼"	3/8"	End of L2
L2	18 bare	3½	½"	3/8"	
L3	18 bare	4	¾"	3/8"	
L4	22 insul	2	¼"	3/8"	End of L3
L5	24	15	3/8"	on 6/32 paper tube	Tap in center

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MAGNETIC *DEFLECTION for* SSTV

Kevin Gorga WB2ZIV
1830 Ferguson Street
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Because of the lack of inexpensive electrostatic deflection CRTs on the surplus market and the impracticability of electrostatic deflection on CRTs larger than 5 in., I managed to apply magnetic deflection to my SSTV station. Magnetic deflection tubes such as the 5FP7 and 7BP7[1] are currently inexpensive and available in large quantities on the surplus market; therefore, they extend themselves to use by amateurs on SSTV with limited resources.

The heart of my magnetic deflection system is the deflection yoke, which needs some explanation. The yoke is a radar type which was to be used in an electronic (rather than mechanical) rotary sweep system[2]. The square yoke is a more common older version, and the round yoke is a newer version manufactured by Atlas Coil Co. for RCA. However, both types are electrically identical. The coils have between 60 and 300 ohms dc resistance, and they have a common red wire to which B+ is connected (Fig. 1).

These coils, though seldom advertised, are rather inexpensively acquired from surplus dealers because of their supposed uselessness. My neighborhood surplus dealer had 15 of these yokes selling for $2 apiece. If you're unable to obtain these coils locally, try writing some of the mail order dealers about them; chances are they'll have some. If this fails, I am able to supply a limited quantity at $2 apiece plus postage. You might also be able to obtain an assembly which contains them, such as the BC-1092. One word of caution: Make sure the coils are for the electronic system. The best way to be sure of this, if they're in a radar unit, is to check around the neck of the tube for a selsyn; if there isn't one, you're probably in luck.

Standard 55-degree deflection coils for TV are too inefficient at the scanning frequency to be used with anything less than 200 mA of current. However, they may lend themselves nicely for transistor work.

The deflection amplifier tubes aren't critical. Any tube capable of handling the required current can be used. To determine the required deflection current you can put a low voltage dc supply and a meter on the coils, as shown in Fig. 2. Bring up the voltage (6–12V) until the beam is fully deflected from the center to one side and that current is your required deflection current. The B+ common on the coil can be found by a resistance check since all four coils have identical resistance.

In MacDonald's SSTV monitor[3] it was necessary to change R10 from 50 MΩ to 30 MΩ to get adequate vertical deflection on a 7 in. tube. The .006 μF coupling capacitor from pin 1 of the vertical trigger to pin 1 of the vertical discharge tube should be increased to .05 μF to discharge

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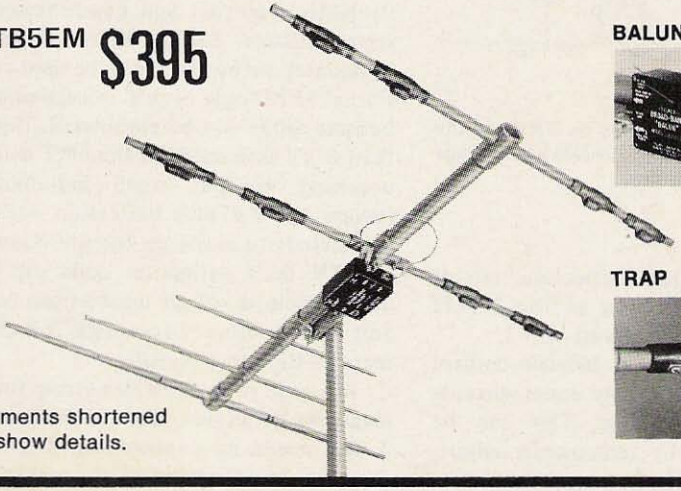

Elements shortened to show details.

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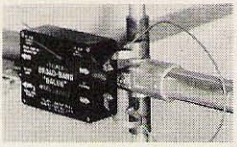

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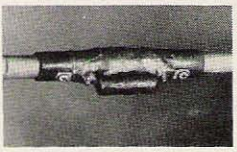

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C3 due to the higher charging voltage. Transformers T3 and T4 in the video circuit can be changed to a plate-to-push-pull-grids (1:2 ratio) interstaged transformer since breakdown voltage no longer is a critical factor.

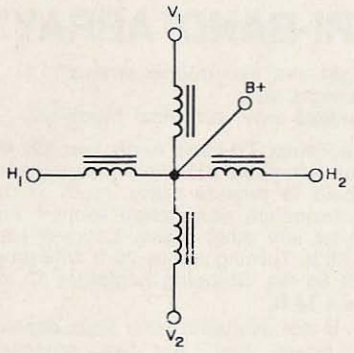

Fig. 1. Radar deflection yoke.

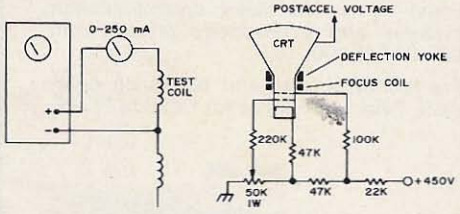

Fig. 2. Coils must be mounted on CRT and the CRT must have the same postaccelerator voltage as your monitor will supply.

The input to the deflection circuit should be at the junction of the 27 kΩ resistors in the cathode circuit of V7.

The 200Ω wirewound balance control should be set so that nearly equal currents are drawn by each tube. This can be determined easiest by temporarily adjusting the bias controls for maximum resistance, grounding the grids, and removing screen voltage. Then adjust the control to approximately equal voltage on the cathode.

The 500 kΩ bias controls should be set by feeding a 15 Hz signal into the amplifiers and putting a scope on the cathodes of the output tubes. (On the 15 Hz amplifier one end of the cathode bypass has to be removed temporarily.) Adjust the bias control for the best sawtooth wave forms on the scope. Since the vertical signal is practically dc (.075 Hz), the 15 Hz signal will have to be temporarily used in making the bias adjustments for the vertical deflection amplifier. Slight balancing can be made with the bias controls, if required, as long as the waveform doesn't change too much.

If a 5 in. tube is used it may be necessary to increase the screen resistor to lower the sweep of the unit, or a 100 kΩ 2W pot could be wired in if a gain control is desired. If a larger CRT is used it will be necessary to increase plate voltage and perhaps change tubes, depending on how much deflection is needed. Keep in mind that if a larger CRT is used it must have approximately a 55-degree deflection angle.

The high voltage required for the electrostatic CRTs can be eliminated, although a 4 to 8 kV (depending on CRT) postaccelerator rf supply will have to be built. An alternate circuit for the −120V line in the monitor is shown. The rf supply is fairly straightforward; C1 and L1 are resonant at approximately 15.750 kHz. Almost any horizontal output tube can be used for V3. For a 5FP7 only 4 kV is needed so the booster diode can be eliminated. If greater than 8 kV is needed for the CRT it may be necessary to put some inductance in (where the TV set's deflection coils were connected) to make up for not connecting the TV set's deflection coils, or if this doesn't help, a voltage doubler can be used. Just add another 2-turn link for the filament of the other rectifier.

The new voltage divider string for most magnetic deflection tubes is shown in Fig. 3 and needs no explanation. The .01 μF capacitor is connected to the grid of V1 to supply vertical retrace blanking, and can be moved to the plate of V2 if more blanking is required. If this capacitor is connected to the grid of V1, a 600V unit will do well; otherwise, a 3 kV unit will be needed because of the inductive kick of the deflection coil when the vertical sync pulse comes.

For focusing of the CRT a permanent magnet unit with a centering control would

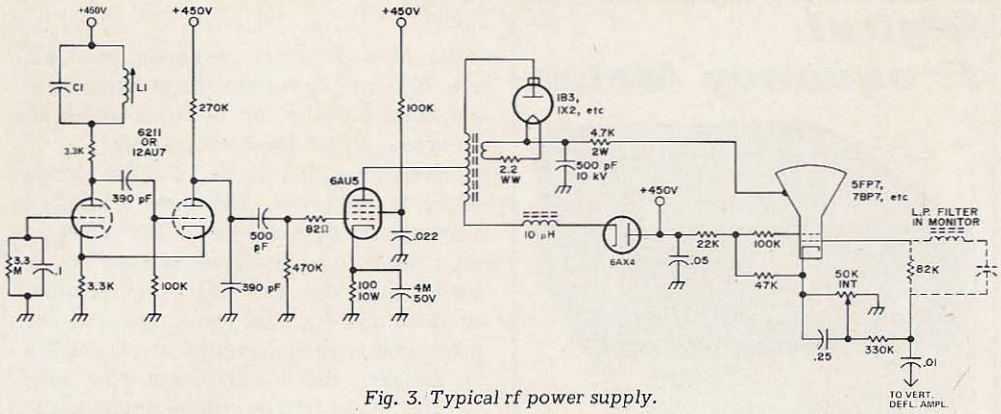

Fig. 3. Typical rf power supply.

be best. If an electronic focus is desired, the circuit in Fig. 4 can be used for most focus coils. Do not be tempted to connect this to the 250V line since this is arrived at by a dropping resistor, and the changing current of the focus coil with adjustment will vary the 250V line.

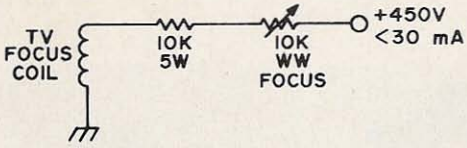

Fig. 4. Electronic focusing circuit.

As for the B+ power supply, remember it will have to supply an additional 160 mA for the deflection amplifiers so make sure the transformer can handle it. Also make sure the supply is filtered well enough so ripple doesn't appear.

If this type of deflection is wanted for a flying-spot scanner such as K7YZZ's[4] it could be done by using the circuit in Fig. 5. I suggest that this cathode follower be used even if you are using an electrostatic tube. I encountered too great a voltage imbalance on my electrostatic deflection amplifiers to get them to operate linearly.

I would also suggest the use of a blue filter on the face of the CRT, if a P7 phosphor is used, such as "surprise pink"

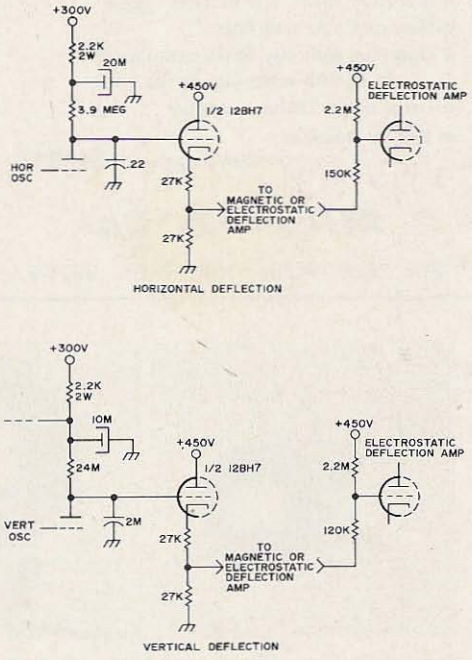

Fig. 5. Modifications for using magnetic or electrostatic deflection on K7YZZ's flying-spot scanner.

(the surprise is that it's blue) or "steel blue." These gels can be bought for 40¢ from a theatrical supply house.

Also, mount the photomultiplier tubes at least 4 or 5 in. away from the card and slightly on an angle as shown in Fig. 6. This is to reduce shading. If the PMT is going to look directly at the CRT, mount it at least 8 in. away to reduce parallax. In any case,

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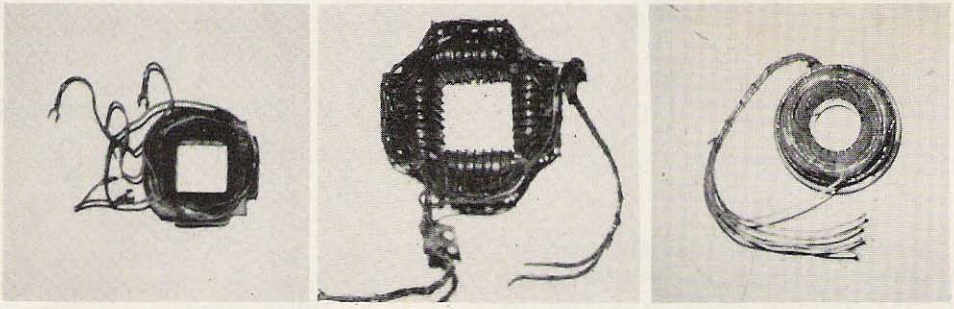
make sure the boxes containing the CRT and PMT are light-tight. Paint the insides flat black and use felt or foam rubber to fill in any gaps in the wood joints.

Remember that in the monitor driven sweep is employed. Therefore, it will be necessary to be receiving an SSTV picture for a raster to be displayed. If a test tape is needed you can send me or most other hams on SSTV a 3 in. blank tape with the speed you wish it recorded at (3 and 3/4 ips usually) and I will record you some pictures. (Also, if you require a tape of the three audio tones I can record that for you, but please include return postage.) I would also like to hear from other hams building SSTV or fast-scan TV equipment. If any difficulties in constructing this equipment are encountered feel free to write me.

I hope this article will help you get on SSTV with as little difficulty as possible. I would like to thank Doug (WB2UDF) and Bob Beach (WB2WRX) for their support on the project.



These deflection yokes are essentially identical even though their configurations differ. The square yoke is the older type. The round one, relatively modern, is manufactured for RCA.

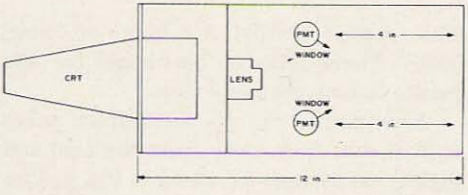


Fig.6. Photomultiplier positioning and optical system layout.

References:

[1] Sources for CRTs:
Arcturus Electronic Corp.
Fair Radio Sales Co.
United Radio Co.

[2] *Radar System Fundamentals*, TM11-467.

[3] *A Compact Slow-Scan TV Monitor*, MacDonald, QST, March 1964.

[4] *A Slow-Scan Television Picture Generator*, Hutton, 73, October 1967.

. . . WB2ZIV ■

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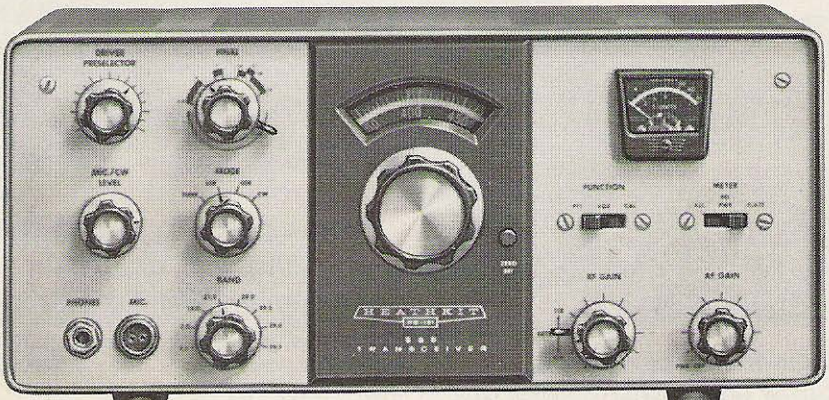

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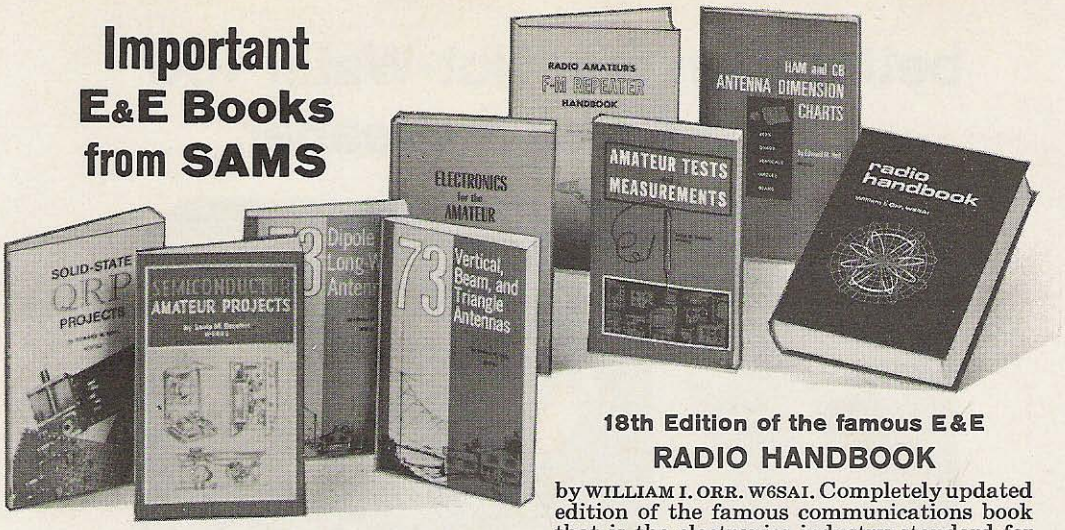

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by Ken W. Sessions, Jr.
K6MVH

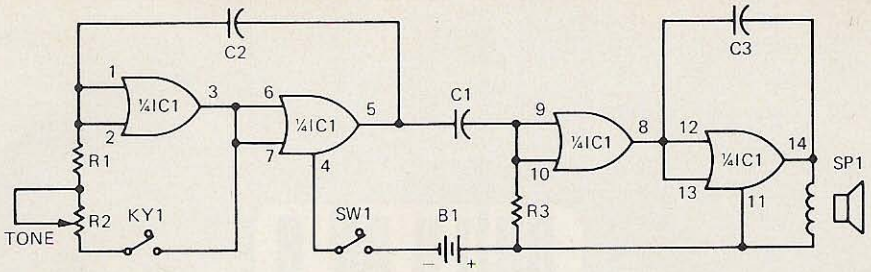
BUILD AN 8 TRANSISTOR CODE OSCILLATOR WITH JUST 1 IC

A code practice oscillator is practically always a simple affair. But with a good IC, such as Motorola's HEP 570, the project can be made even simpler while the circuitry itself – within the integrated circuit – stays complex enough to assure plenty of audio gain, good stability, and excellent quality of tone.

The oscillator described here was designed by experts at Motorola, who allowed for four "discrete" stages, each with a two-transistor capability, within the framework of the lone flatpack IC package. One of the nicest features of the HEP 570 as the oscillator element is its economy of external parts. Apart from the power switch, the telegraph key, the speaker, and the battery, the only additional components required are two resistors, a pot, and three capacitors. What could be simpler?

Construction is as simple as the schematic (Fig. 1) makes it seem. One item not shown on the schematic, however, could make the job easier and save the insecure builder a great deal of grief: a suitable socket for the IC. An advantage of using IC sockets is that if all does not go well right off, the IC remains isolated from the rest of the circuit while changes are incorporated. Also, most hams use their ICs again and again, for any number of appropriate projects. Soldering of an IC directly into a circuit will seriously curtail its universal utility. The package can't stand too many solder/unsolder operations before the leads give out. But with a socket, the IC stays like new and may be used in as many projects as the builder has sockets for. And changing the IC from one project to another is no more difficult than making a tube change in an old-fashioned rig.

Your junkbox will undoubtedly yield the resistors and capacitors necessary to complete the oscillator project, but it is unlikely that you'll find the right speaker kicking around the shack. Since the output of the amplifier/oscillator is in the vicinity of 50Ω, a standard "intercom-type" speaker is required. If the expense of such a speaker proves a bit much, there are



PARTS LIST:

IC1	HEP 570	R3	10 K	SW1	SPST	SP1	45 Ω INTERCOM 4" SPEAKER
R1	3.9 K	C1, 2	.05 μF	KY1	MORSE KEY		
R2	10 K POT	C3	.001 μF	B1	3 VDC		

Fig. 1. Schematic of the "8-transistor" code practice oscillator made with a Motorla HEP 570 IC.

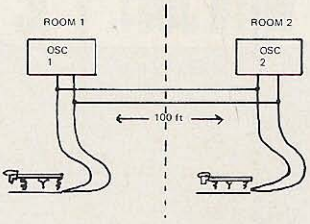


Fig. 2. If the distance between operating stations is held down to a reasonable value a CW intercom setup can be made with two or more code oscillators. If you've got kids in the family who can't find time to practice their code for the Novice exam, this arrangement is sure to turn the trick.

other routes that might prove entirely satisfactory, such as scrounging up matching transformers that can be used to drive either a speaker or an external amplifier arrangement.

One method that has proved adequate is to use an ordinary low-voltage power transformer to couple from the IC to the speaker. A transformer with a primary winding of 120V and a secondary of 12V provides a reasonable approximation of the proper turns ratio, and will deliver a fairly healthy audio signal to a 3.2Ω voice coil. Since power-handling capability is no consideration, you can use the smallest physical size of transformer you can get your hands on. The only disadvantage with this approach is that it plays hob with any attempt toward miniaturization.

A small chunk of perforated board makes an ideal mounting bed. If the small intercom speaker is in your list of "availables," you can easily mount the whole affair in an enclosure no larger than a tiny portable radio. If you have to use the power transformer, you'll have to just poke around for a chassis with enough bulk to accommodate everything.

An obvious "extra" that will enhance the usefulness and attractiveness of your oscillator are matching jack and plug for the sending key. This will also simplify the use of another code oscillator for two-way operation.

To couple a pair of code oscillators for two-way use, it is better to parallel the keys rather than the speakers themselves. This approach keeps each unit from the labor of driving more than its fair share of the load. Figure 2 illustrates an excellent room-to-room interconnect method that has already been used to bring two new Novices to the bands. (Learning the code is fun if there is some incentive to study; and a room-to-room CW intercom will work wonders with harmonics who might otherwise be reluctant to practice.)

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The Beeper is ideal for hidden transmitter hunts, since its off-on transmitting cycle adds to the difficulty of getting a fix on the

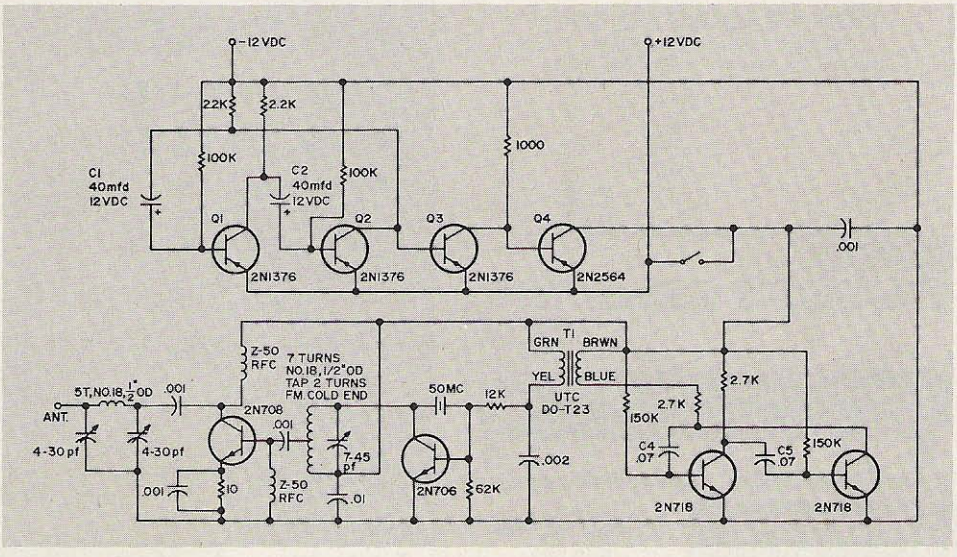

Fig. 1. Schematic for the Beeper. All resistors are ½ watt.

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hidden unit. Amateur rocketeers should find this circuit ideal for use in larger-sized rockets. A miniaturized Beeper located in the nose-cone of a downed, lost rocket would aid greatly in finding it.

The Beeper emits a tone-modulated six meter carrier which cycles off and on. The heart of the unit is the transmitter which consists of a 2N706 overtone oscillator followed by a 2N708 amplifier. The transistors used in the transmitter are not critical. Literally any NPN rf transistor can be used with good results. I tried an epoxy transistor from a scrapped uhf tuner in the final. The output increased 25%. The output is normally 100 milliwatts or better.

Even though the duty cycle on the transistors is light in the Beeper due to the rf cycling, the transistors do get quite warm if the flasher circuit is jumped out of the circuit. In any case, a simple heatsink can be made for the amplifier with a pair of tin snips and some aluminum stripping. The crystal oscillator uses a 50.385 MHz overtone crystal. I was able to get several from a surplus crystal outlet for $1.60 each. The crystal I used doesn't use a socket, but is wired into the circuit. Leave at least 1/2 inch of wire on each lead and use heat sinks when soldering. Excessive heat will ruin these crystals and an ounce of care may save you $1.60 plus postage. Sockets were used for the transistors in my unit since I wanted to try the several kinds I had on hand to find which would give the best results.

The modulator is a multivibrator coupled into the base of the 2N706 oscillator. The modulation was judged to be in the neighborhood of 75%. Unfortunately, I was unable to get enough rf to give a readable pattern on a scope. However, if the signal is strong enough to move the S-meter, it can be heard.

Both the multivibrator and the transmitter derive their operating voltage from the output of a light flasher circuit developed by RCA. The flasher circuit consists of transistors Q1, Q2, Q3, Q4, and their associated parts. Notice that while the flasher circuit uses PNP transistors, the transmitter and modulator use NPN's. Since the output of the flasher is negative, the flasher must break the negative ground return of the modulator and transmitter. The rate of the flasher can be changed by adjusting the values of C1 and C2 until the desired rate is found. An increase in capacitance will increase the time interval between beeps. The length of the beep itself may be changed by changing the value of C2. If you desire to vary the tone of the beep, changing the values of C4 and C5 will do the trick. A word of caution—multivibrators are inherently rich in harmonics and, if you are not careful, you can get a pretty wide carrier out of the Beeper. With the values shown, the Beeper will be modulated by a tone of about .5 kHz with a bandwidth of less than 25 kHz. Transformer T1 tends to limit the high frequency response eliminating serious spurious sidebands.

The prototype was constructed on a springboard to aid in designing and part substitution. The finished unit was built on a small piece of Vectorboard. Care should be taken to provide a good ground for the transmitter stages. They are slightly regenerative and poor grounding may set up a feedback loop. The best way to build the unit would be for the more industrious ham to make his own circuit board. Since most of us are weekend experimenters this approach may not be too practical.

To facilitate tuning up the transmitter, the flasher circuit should be bypassed. Connect a number 47 pilot light to the rf output jack; this will serve as a dummy load and rf indicator. For the initial tuning, no more than 9V should be used. First tune the oscillator (C10) for maximum as indicated on a nearby receiver, grid dipper (in the wavemeter mode), or a sensitive field strength meter. As you increase the capacitance, the output will become greater and then suddenly quit. Check this on a receiver, as the oscillator may break into spurious oscillation. When the point is found where the output is greatest, turn the capacitor back 1/8 turn; this will insure that the oscillator will start after the voltage is removed and turned on again.

After the oscillator is tuned, proceed to adjust C8 and C9 for maximum output as indicated on the 47 bulb. The final tuning may interact with the oscillator so you may have to adjust both until you get the desired

results. The transmitter adjustments may affect the quality of the modulation, so listen to the signal on a receiver to make sure everything is to your satisfaction. Now connect the flasher circuit. The Beeper should start to beep off and on. If it doesn't, check the flasher output with a voltmeter; if it is okay, chances are that the oscillator is not breaking into oscillation. Readjust C10 if this is the case.

When the Beeper is connected to a 12V volt power source, there should be enough rf present to light the 47 pilot lamp to half brilliance. My Beeper will operate with less than a volt. Don't be tempted to increase the voltage to gain more output. The unit draws 20 mA when it is not transmitting and about 150 mA while transmitting.

Never operate the Beeper without some form of load, and try to provide as good a match as possible. The modulation quality seems to be directly related to the quality of the antenna used, and a good antenna is also cheap transistor insurance. Generally, the transmitter will not have to be retuned after the initial settings are made, and the final tuning is quite broad. A quarter wavelength of wire will radiate a signal over several miles of open terrain. I was able to receive the signal two miles away from the Beeper with a Lafayette HA-650 portable transceiver using the whip antenna supplied with the HA-650. With the same setup and using the S-meter on the HA-650, I was able to locate the Beeper within a few feet of where it was hidden by a friend.

The Beeper can be put together in a few evenings. Most of the parts used are not critical, and it should be easy to find substitutes for most of them. The UTC transformer which I specified for use in the modulator may be difficult to find. If one is not available, almost any high impedance interstage transformer will work satisfactorily. If you desire, the flasher circuit and/or the modulator can be eliminated from the Beeper.

The Beeper does its job well, and it can provide its owner with many hours of fun. Why not build one and then get the local six meter group together for an old fashioned transmitter hunt? Happy Beeping!

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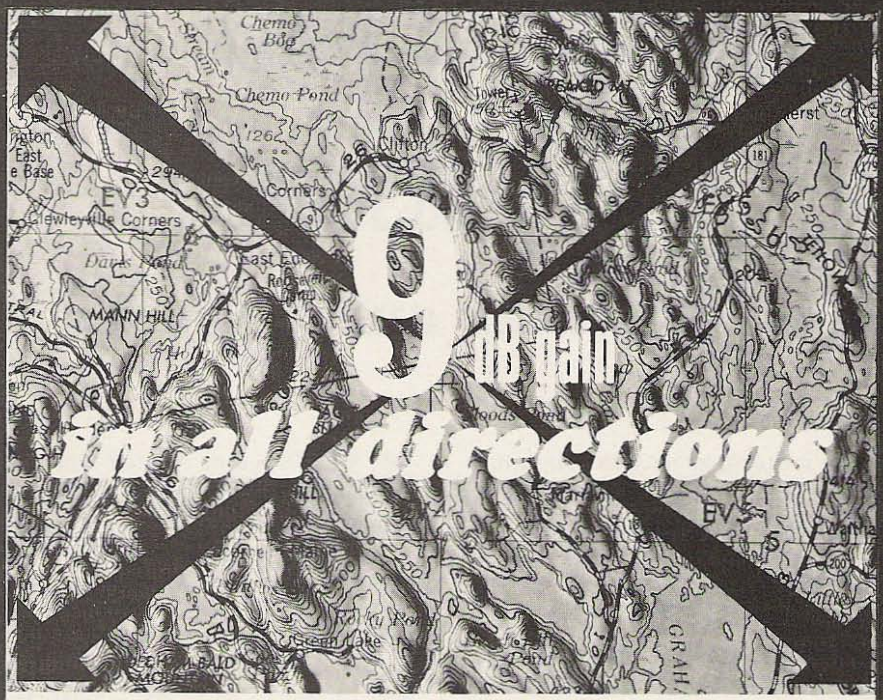

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STUDY GUIDE GENERAL CLASS LICENSE

Part VI Gazintas and Gazoutas

By now it should be obvious that in this wacky world of electronics and ham radio, everything depends upon everything else – which makes it most difficult to name a single component as "the cornerstone" on which the whole setup rests.

But were it necessary to do so, the amplifier would be a prominent candidate for the position. Without amplifiers, neither radio nor any other application of electronics as we know them today could exist. Amplifiers are an essential ingredient of every oscillator, of every transmitter, and of every receiver, and in their absence we could expect little more performance than Marconi achieved seven decades back.

Because amplifiers are so essential, a number of questions on the General class examination are intended to test the applicant's knowledge of them, and many others which do not deal on the surface with amplifiers as such nevertheless require a knowledge of amplifier principles to answer.

In this chapter, we're going to discuss amplifiers, and cover the study list questions which deal directly with this subject.

Questions dealt with are:

20. What are some possible causes of excessive plate current in a class C power amplifier?

45. List the three main classes of amplifier operation and explain the use for which each class is best suited.

47. What is meant by "flat-topping" of a single sideband signal and what are some possible causes of it?

48. What does grid current flow in a class A amplifier indicate?

As usual, rather than dealing with these questions specifically, we'll rephrase them into more general ones.

For a start, let's ask "What is an amplifier?" This basic knowledge will be necessary in order to classify amplifiers into the three main classes.

We can continue by asking "How are amplifiers classified?" This is not just a rewording of question 45, because a number of classification techniques exist, one of which has only two main classes (and which makes more sense in general than the conventional approach, though it's not the answer the FCC expects).

Once we know what we're talking about and how they are classified, we can wind up the discussion on a more practical note with "How and why do amplifiers misbehave?" In getting answers to this, we'll cover most of the more common types of problems encountered,– but we hasten to point out that it's impossible to cover all the problems, because many are highly improbable and so occur at such extended intervals that no one person could hope to list "all" the possible troubles with amplifiers. Fortunately, a solid knowledge of basic principles goes a long way toward helping cure these "rare diseases" of the circuits.

What Is An Amplifier?

Several acres of paper could be (and probably have been) covered with words in unsuccessful attempts to provide detailed answers to the question "What is an amplifier?" It gets complicated because an amplifier need not contain either tubes or transistors (although most of those you're likely to meet in amateur radio and particularly in the FCC exams do), and for that matter need not even be an electronic device!

For instance, one of the simplest imaginable amplifiers of mechanical force is a lever, or pry-bar. Our amplifiers are, in some ways, merely the electronic equivalent of levers.

In electronics, though, the range is a bit more limited, and we can define an amplifier in general as a circuit which increases the power level of an electrical signal. Most such amplifiers have at least two "ports" or sets of terminals, one for "input" and the other for "output" – and thence comes the possibly puzzling title of this installment, because some technicians with a high disregard for engineeringese like to refer to these ports as the "goes into" and "goes out of," slurring the words to "gazinta" and "gazouta."

As we've defined it here, then, an amplifier is a device with an input and an output port (Fig. 1), and any signal fed into the input will appear at higher power level at the output. This definition isn't really tight enough to get through engineering courses with, but it's good enough for everyday use.

Fig. 1. Any amplifier can be considered to be a black box with two ports, one for input and the other for output. Amplitude of signal applied to input is changed by amplifier as signal passes through to output.

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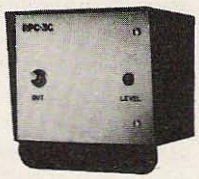

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It leads, naturally enough, to another question, though. If an amplifier boosts the power of a signal, then what, pray tell, is a "signal"? As we use the term throughout this study course, a signal is a sequence of electrical power levels which, by their variation, carry some sort of information. This information may be the mere fact that the signal is present (as in a power signal), or it may be as complex as a composite video/audio TV broadcast signal.

The reason we define signals as "sequences of power levels" rather than in terms of "voltage" or "current" variations is that voltage and current have little significance of their own when we speak of signals – only the combination of voltage and current (or power) is meaningful. For instance, a simple transformer can double the voltage present in a circuit, but it doesn't change the power level much, and the change it does introduce is loss rather than gain. Therefore a transformer is *not* an amplifier.

The only types of amplifiers we'll be

going into much detail about here are those which employ vacuum tubes or transistors as their "active devices" or amplifying elements, although other kinds are possible. Some of these other kinds include magnetic amplifiers, which change the coupling in special kinds of transformers, and diode amplifiers, which make use of special properties of certain special kinds of diodes. The common types, though, use tubes or transistors, and since those are the ones covered on the FCC exams, they're the ones we'll concentrate upon in this course.

In these amplifiers, the "power" characteristic of a signal which we mentioned a few lines back is of critical importance, since almost all common amplifier circuits make use of their active devices as variable resistances which "valve" steady new power from a power supply into the output circuit, under control of the input signal. We've already examined this action in vacuum tubes and in transistors. The only new point we're making now is that this variable-resistance property of the device is the normal situation in most practical amplifier circuits you're likely to run across.

As we saw much earlier, the relationship between voltage and current at any one point in a circuit may be described in terms of resistance or, more generally, impedance. Since most practical amplifiers operate with ac signals, "impedance" is the way it's specified. The characteristics of an amplifier's ports are usually described in terms of their impedance level, and either the voltage, current, or power to be applied there. With impedance specified, voltage, current, and power are virtually interchangeable units, since the current or the power may be calculated if voltage and impedance are known, and similarly voltage may be calculated if current or power and impedance are known.

This specification is usually given in terms of the maximum signal level, and it's not at all uncommon to find an amplifier's input rated in voltage/impedance while the output is rated in watts. Many hi–fi rigs, for instance, are rated for a maximum 50W out at 16Ω, and maximum 0.5V in at 500 kΩ. These port ratings are important, but they do not normally tell us much about the amplifier's performance. Performance of an amplifier is usually described in terms of gain and distortion, but this may vary depending upon the use to which the amplifier is to be put.

The gain may be given either in decibels, or as a ratio, so that it becomes difficult to compare amplifier ratings. A typical rf linear amplifier might be rated for 10 dB gain, input and output impedances of 52Ω, and require 100W input for maximum output. Such an amplifier would produce 1 kW output (10 dB gain with input of 100W). A hi–fi rig, on the other hand, might completely neglect to mention gain and merely give output and input levels together with distortion percentages.

Regardless of ratings, any normal amplifier operates by regulating the flow of current in its output circuit. If the amplifier is intended for use as a voltage amplifier (one in which the power gain is used to step up the signal voltage rather than signal current), the resulting variations in output current flow are converted back into voltage variations by means of a coupling device which may be a transformer, a resistance, or an impedance. Most of today's amplifiers use resistance coupling (Fig. 2); as the current through a resistor in series with the active device varies, so does the voltage drop across that resistor. This

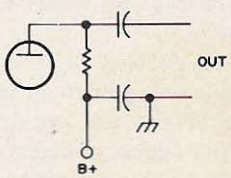

Fig. 2. Most common amplifier output coupling circuit at audio frequencies is resistance-coupled version shown here. Lower capacitor is not obvious on most schematics since it is called a bypass capacitor, but it serves the purpose of taking output as voltage drop across load resistor.

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varying voltage drop is coupled out through a capacitor (to isolate the dc component of the signal) to the output port.

With transformer coupling (Fig. 3) the active device's operating current is supplied through the primary of a transformer. As this current varies, the changes induce corresponding current in the transformer secondary, which is connected to the output port.

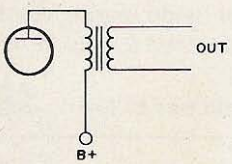

Fig. 3. Transformer-coupled circuit shown here is sometimes used in audio amplifiers, and often employed at rf where tuned tank circuits form the transformer. Transformer can produce highest efficiency of all coupling circuits, but is more costly than a resistor and two capacitors.

Resistance coupling is normally inherently high-impedance, although certain special circuits can bring the impedance level down to low levels. Transformer coupling, on the other hand, seldom produces extremely high impedance levels. It is used primarily to produce medium- to low-impedance ports, as for instance in the output circuit of a vacuum-tube hi-fi unit where the tubes' current must drive a 16Ω load. Rf amplifiers often use transformer coupling because an rf transformer can be composed of tuned circuits for selectivity; sometimes they use impedance coupling (Fig. 4) which is similar to resistance coupling except that an rf choke (inductor) replaces the resistor.

As you can see, amplifiers operate in many different ways, even though their basic principles are all similar. Because of

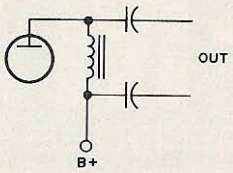

Fig. 4. Impedance-coupled circuit shown here is cross between transformer and resistance coupling. Ac output signal sees high impedance at choke, and capacitors couple out the resulting voltage drop. Tube's dc power, however, is not restricted.

this, it's been found necessary to classify amplifiers into various types for study and discussion. Many classification schemes are in use, and some of them are so widely accepted that they are part of the FCC examinations.

How Are Amplifiers Classified?

Just as we have many kinds of amplifiers, we have many kinds of amplifier classifications, because amplifiers are classified into groups, each of which has some character or property in common.

We finally restricted our definition of amplifier, for this chapter at least, to "a vacuum-tube or transistor device which boosts the power of its input signal" – and that in itself was a classification.

Within this classification, we could describe amplifiers according to their output coupling circuit. This would produce classifications such as "resistance-coupled," "transformer-coupled," and "impedance-coupled," which we were using only a few paragraphs back.

Another way would be on the basis of the frequency range handled by the amplifier: audio, video, rf, i-f, dc, etc.

We could divide them into voltage amplifiers, in which the power boost shows up as increased voltage with no decrease in current, and power amplifiers, in which the power boost is used directly.

All of these classifications are in wide use, but none of them attack the problems

of amplifier operating conditions directly. Thus, an rf power amplifier may be linear, or it may produce distortion, and these classifications will not help us determine why it acts as it does. To handle such needs, we must have a classification system which is based upon operating conditions – and one exists in an almost universally standard form.

The definitions published by engineering societies the world over, as cited in Terman's monumental text on *Electronic and Radio Engineering,* in the third and fourth editions of *Reference Data for Radio Engineers,* in Langford-Smith's *Radiotron Designer's Handbook,* and in Eastman's *Fundamentals of Vacuum Tubes,* are as follows:

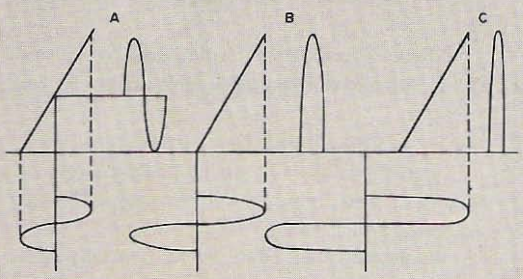

Fig. 5. Comparison of class A, class B, and class C operating characteristics is shown here for "ideal" amplifiers having perfectly linear characteristics across limited range. Diagonal line represents amplifier's action. Vertical lines indicate grid bias setting of amplifier; in class A, bias splits the operating range in half, while in class B only the positive-going half of the input signal is amplified, and in class C only a part of the positive-going half makes it through. No actual amplifier has such a straight characteristic, but this illustrates the differences in the classifications.

Unfortunately from our point of view, one authority defines these classes in a manner which is significantly different from the definitions agreed upon by most other authorities – and most hams have learned the classes from the one unique authority. This leads to an inordinate amount of confusion, disagreement, and downright unpleasantness at times. The best way to avoid this trap is to become familiar with both sets of definitions, and to know that two different sets exist; then you can pick your set according to the other fellow's rules, and discuss theory freely.

Incidentally, the key differences between the two sets of definitions do not appear in the FCC study-list questions, so they should pose no problems during the actual examination.

The classification system of which we speak divides all amplifiers into three broad classes, called "class A," "class B," and "class C" (Fig. 5), and goes on to define an overlap group called "class AB," which is a twilight zone between class A and class B.

"A class A amplifier is an amplifier in which the operating conditions are such that plate current in a specific tube flows at all times.

"A class B amplifier is an amplifier in which the grid bias is approximately equal to the cutoff value so that the plate current is approximately zero when no input signal is applied, and plate current in a specific tube flows for approximately one-half of each cycle when input signal is applied.

"A class C amplifier is an amplifier in which operating conditions are such that plate current in a specific tube flows for appreciably less than one-half of each cycle when input signal is applied and plate current is zero in the absence of input signal.

"A class AB amplifier is an amplifier in which operating conditions are such that plate current in a specific tube flows for appreciably more than half but less than the entire electrical cycle of the input signal."

We'll look at these definitions in much more detail shortly. First, however, let's

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look at the conflicting set of definitions for classes A, AB, B, and C, as published in the widely circulated handbook for radio amateurs published by the ARRL (quotes are from the 1962 edition):

"A class A amplifier is one operated so that the wave shape of the output voltage is the same as that of the signal voltage applied to the grid . . .

"A class AB amplifier is a push-pull amplifier with higher bias than would be normal for pure class A operation, but less than the cutoff bias required for class B . . ."

(Class B operation is defined by means of a schematic diagram and four waveforms.)

"A radio-frequency power amplifier . . . can be used with an operating angle of less than 180 degrees. This is called class C operation."

It may appear that we're overemphasizing the differences in these sets of definitions, but in nearly 20 years of listening to on-the-air bull sessions get downright acrimonious simply because two people attempting to discuss amplifier operation didn't mean the same thing at all by "class A" or "class AB" or "class C," we feel that the existence of multiple definitions is an essential fact to know.

The major significance of the differences is that the engineers' version is based *entirely* upon an operating characteristic which can be precisely measured and specified; the flow of plate current in the amplifier throughout one cycle of an input signal determines that amplifier's operating class. If plate current always flows, it's class A. If current is cut off for part of the cycle, but less than half, it's AB. If cutoff is for approximately half a cycle, it's B. And if cutoff is appreciably more than half a cycle, it's class C.

The "amateur" definition, on the other hand, defines each different class by means of a different characteristic. It says that a class A amplifier is one which is free of distortion (that may not be what was intended, but it's precisely the meaning of the words used in the definition, and it's the way most people read them if you listen to the resulting arguments), while a

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class AB amplifier must be push-pull, and class C applied to rf power circuits.

Obviously, we're somewhat biased in favor of the engineers' definitions. They appear to be much more precise, and should you happen to be interested in radio engineering from a career viewpoint, they'll do professionally as well as in your hobby. Now let's examine them more closely, and then see how the somewhat looser "amateur" definitions are related to those of the engineers – because in a most general and highly oversimplified way, the "amateur" definitions usually apply also.

The "class A" amplifier concept was originally intended to be that of an "ideal" amplifier which reproduced its input signal at the output, without distorting it in any way. In order to accomplish this, it would be necessary for gain to remain constant regardless of the signal level, and plate current could never cut off during the input-signal cycle (because if it did, that part of the cycle appearing at the input while current was cut off would fail to appear in the output, which would constitute distortion).

The engineers' definition of class A stems directly from one of the requirements of the "amateur definition" – but the reverse is not true. An amplifier can meet the engineers' definition even if plate current varies widely throughout the signal cycle, just so long as it never cuts off. With a wide variation of plate current, gain will also vary between wide limits, and the output signal will be distorted. In this case, the output signal will *not* have the exact same wave shape as the input, so the amateur definition is not fulfilled.

The class B amplifier represents an attempt to improve the efficiency of amplifier circuits, and dates from the days when radios all operated from batteries (before ac power supplies were available). A class A power amplifier cannot develop much output power in comparison with the power it takes from the power supply, since plate current must flow even when no signal is present in order to remain class A and this plate current is wasted so far as developing output is concerned. As a result, class A amplifiers normally produce a maximum of

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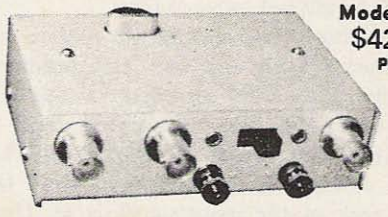

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about 1W out for every 4W drawn from the power supply.

By drawing power only half of the time and leaving the tube cut off for the other half of the input cycle, less power is wasted. On the other hand, with only half of the input signal appearing in the output, distortion of the amplified signal is extreme. Use of two tubes in a push-pull circuit reduces the distortion to acceptable limits, because while one tube is cut off the other is providing output and vice versa – and the push-pull connection is necessary in order to use class B operating conditions in audio amplifiers.

In an rf power amplifier, however, distortion of the individual cycles of rf does not matter because the tuned circuits have a "flywheel" effect which irons out the distortion. "Distortion" in rf power amplifiers usually means a distortion of the signal "envelope" or modulation, and this is not affected by the class B circuit. Therefore it's possible to use single-tube class B amplifiers in transmitters, and some "linear" amplifiers operate this way.

The ideal class B circuit is about twice as efficient as the same tubes would be if operated class A; that is, it provides up to 2W out for every 4W taken from the power supply. This means that batteries for such a circuit would last twice as long.

The class C operating conditions are just like class B, only more so. One textbook describes them, very accurately, as "switching" operation. The tube or transistor is operated with bias so far into cutoff that plate current cannot flow except at the very peak of the input signal cycle. Thus, this class of amplifier draws very little current most of the time. On signal peaks, the tube or transistor switches from "off" to "on" and permits a brief pulse of current to flow. Since it is essentially a switch, this current pulse can have extremely high values – a full ampere isn't uncommon. The high-energy pulse causes the tuned rf output circuit to "ring" at its resonant frequency, and with another pulse coming along at the peak of every cycle, most respectable power levels can be developed.

The class C amplifier can theoretically produce as much as 3.8W of output for every 4W taken from the power supply, but practical circuits seldom deliver more than 3 for every 4. This is still three times as efficient as the same tube would be in class A, and since amateur power limits are set on the basis of input power rather than output power, it means you can get three times as much signal with class C.

Because of the extreme distortion and resulting need for tuned circuits, class C amplifiers are normally used only for rf power amplifiers. However, many computer circuits normally described as being "digital" or "binary" can also be considered as class C amplifiers operating on dc signals rather than rf.

In addition to the three major operating classifications of A, B, and C (class AB is considered to be a cross between A and B), another operational classification is used to indicate whether grid current flows in the amplifier. This classification consists of a numeric suffix applied to the classification letter; a "1" indicates that grid current does not flow, while a "2" means that it does.

Normally, class A amplifiers are A1, and class C amplifiers are C2. Most class B amplifiers are B2. The only place the number has great meaning is with class AB, where about as many circuits operate AB1 as do AB2. However, the presence or absence of grid current does not necessarily go with the operating class in all cases. It's quite possible to design a class A2 amplifier, which permits grid current to flow and yet operates class A, or a C1, which operates class C without any grid current.

At this point it might be well to point out another basis of classification often used, that into "linear" and "nonlinear" amplifiers (Fig. 6). A linear amplifier is one which amplifies its input signal without introducing any distortion, while a nonlinear one does introduce distortion of some type. Since nothing is perfect, all actual amplifiers are nonlinear to some degree, and therefore the term "linear" is always used in a comparative sense. A good

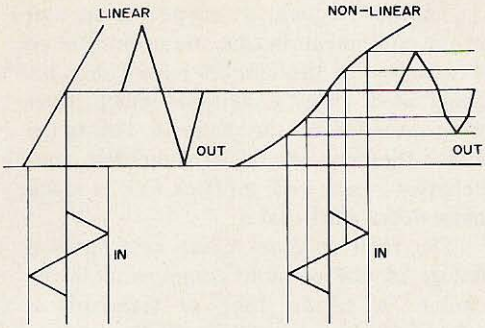
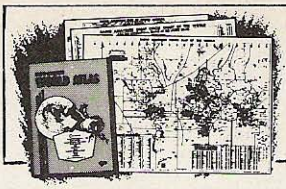


Fig. 6. Here we have linear and nonlinear amplifiers compared, with triangular signal waveforms instead of sine waves to make life easier for our illustrators and bring out the differences which are not obvious with sine waves. Linear amplifier, left, faithfully reproduces input signal at output. Nonlinear amplifier, right, puts bends into the straight sides of the waveform. These bends represent second-harmonic distortion. In general, any distortion is described as "nonlinear" operation.

hi-fi amplifier is linear, for instance, even though it does have some small percent distortion. In speaking of rf amplifiers for modulated signals, the distortion is measured with respect to the modulation rather than the individual rf cycles, and so a linear rf amplifier is one which does not distort the modulation rather than one which does not distort the individual cycles of the input signal.

The linear/nonlinear classification helps us to list the ways in which class A, B, and C amplifiers are used. For instance, almost all linear audio amplifiers operate in class A, which squares with the "amateur" definition of class A as being a linear amplifier. Many rf linears at low power levels also operate class A, and in general the class A operation is used almost exclusively when very low distortion is required. Most receiver circuits are class A.

Class AB and B amplifiers are widely used to produce moderate power levels with limited distortion. The output stages of many public-address amplifiers and almost all hi-fi power stages operate in class AB, and almost all SSB final linear amplifiers run as either class AB or B. In addition class B amplifiers are sometimes used in



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battery-operated equipment to conserve battery power; many transistorized portable radios use class B output stages for this reason.

Class C operation is confined almost exclusively to rf power amplifiers which can be nonlinear; this means, in practice, all rf power stages in a CW or FM transmitter, as well as in an AM transmitter which uses high-level modulation (if modulation is applied before the final output stage, all the following stages must be linear, requiring A, AB, or B operation). Class C is hardly ever used in SSB transmitters, since the nonlinearity would destroy the modulation of the signal.

How and Why Do Amplifiers Misbehave?

Amplifiers, like all other physical objects, faithfully follow Murphy's First Law that says, "If anything can possibly go wrong, it will." In consequence, they continually misbehave. Fortunately, an amplifier is a relatively simple device, so that only a few things in them can possibly go wrong, and the result is that most amplifier misbehavior can be traced to a fairly small number of possible causes.

However, any specific case of "wrong-going" may be due to not just one but several of the possible causes all acting together, which sometimes makes it difficult to find and fix the trouble.

One of the first things which can go wrong is for the specific amplifier to be badly designed; in this case the designer has failed to take into account all the tricky little interactions which can affect his circuit's operation, and you as an operator are just about hopelessly lost. The cure is to forget it, and start over with a properly designed amplifier (if you're the designer as well, then it's back to the drawing board with our sympathy).

Since this kind of problem, though it's the most common in the case of new or one-of-a-kind circuits, is not within the range of the FCC exam, we'll ignore it the rest of the way in and assume that the misbehaving amplifier was properly designed and built and did, in fact, work perfectly at some time before the troubles began.

Another frequent wrong-goer is the user of the equipment; in this case nothing at all is wrong with the amplifier itself, but it's being used under conditions which never were intended by the designer. This is the most frequent cause of amplifier misbehavior – and we'll get back to it in much more detail a little later.

The final frequent cause of trouble is failure of one or more components in the circuit. A blown tube or transistor is relatively easy to find and fix – but a bypass capacitor which has changed in value (because of age or overheating) just enough so that it no longer does its job properly may provide more than its share of hair-pulling before it's detected.

From the standpoint of the operator, the only one of these three probable causes of problems which he can do anything about is the second – misuse of the equipment. The cure for the first is to redesign the circuit, and for the third is to locate and repair the defective part. While both of these are legitimate activities for a radio amateur, neither of them is involved directly with the *operating* of the equipment.

Because of this, and also because misuse accounts for most of the amplifier problems and bad signals in existence at any one instant, we'll concentrate on just the one problem.

Before we can talk about "misuse" of an amplifier, we must know what the proper use for that amplifier is. For instance, the purpose of a linear power amplifier used to bring a single-sideband signal from 10W up to 500W is defined, and "proper use" of this particular rig would be that use which accomplishes the power amplification without distortion and unwanted spurious output signals.

In general, the amplifier's name (such as "linear," "power," etc.) together with the designer's specifications for input and output levels will tell you all you need to know about the circuit's purpose, and proper use amounts to "that use which accomplishes the purpose of the circuit."

Misuse, then, can be defined as any use which defeats the circuit's intended purpose. In most cases, this boils down to one or more of three major mistakes:

1. The amplifier is adjusted to operating conditions such as bias or voltage levels which are outside the range anticipated by the designer.

2. Input signals are applied at levels either lower or higher than the range intended by the designer.

3. More output is attempted than the designer intended the circuit to produce.

Let's see how these three mistakes affect several typical amplifier circuits. For starters, let's see what happens when a class A amplifier intended for low-distortion amplification of an audio signal is misused. Such an amplifier might be in the speech-amplifier chain of any phone rig, or in a receiver.

If the amplifier's bias can be adjusted, and is set to a value higher than the designer intended, the stage will draw less current than it was designed for, and so cannot develop its rated power output (or voltage output, if it's a voltage amplifier).

Similarly, if the bias is set too low, a "normal" input signal may overcome the bias and change the operation condtion from class A to class AB. The effect of bias adjustment, then, is to reduce the allowable input and output signals –,and if the value is very far from the intended level, excessive distortion may be introduced into all signals (Fig. 7).

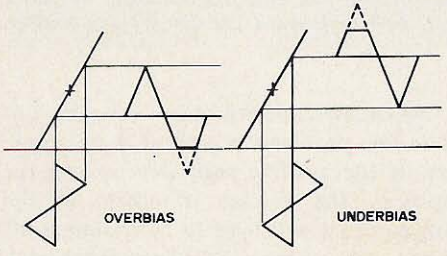

Fig. 7. Shown here are the effects of overbias and underbias on a class A amplifier, with a triangular input signal of maximum rated level which could be reproduced linearly were the bias proper as indicated by the "X" in the center of each amplifier transfer line. Overbias causes the negative-going peaks of the signal to "bottom" against the cutoff point, which is actually class AB operation, while underbias causes amplifer to saturate and flat-top the signal.

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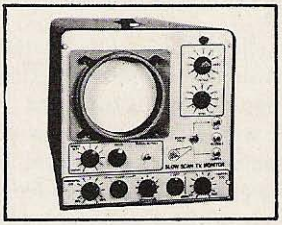

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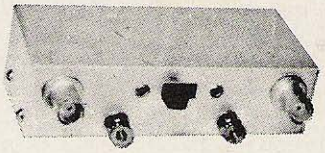

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However, in most class A amplifiers, the bias level is not adjustable by the operator, so this particular example won't be met often in practice.

If the input signal is out of the range intended by the designer, other bad things happen. If the input signal is too weak, the probable effect would be simply low output, possibly contaminated with noise, but most class A amplifiers are intended to work with signals which range right down to the noise level anyway, so the designer has probably intended his circuit to work with input signals approaching zero volts. When grid current flows, the input signal is distorted before it ever reaches the active device, and the distortion can't be removed later. Even if grid current does not flow,it's possible to "saturate" the active device so that it no longer changes in resistance as the input signal changes, and this too leads to distortion.

Meanwhile, the negative-going peaks of the input signal add to the operating bias, and may add to it enough to change the operating conditions to class AB instead of class A. This also produces distortion in the output signal.

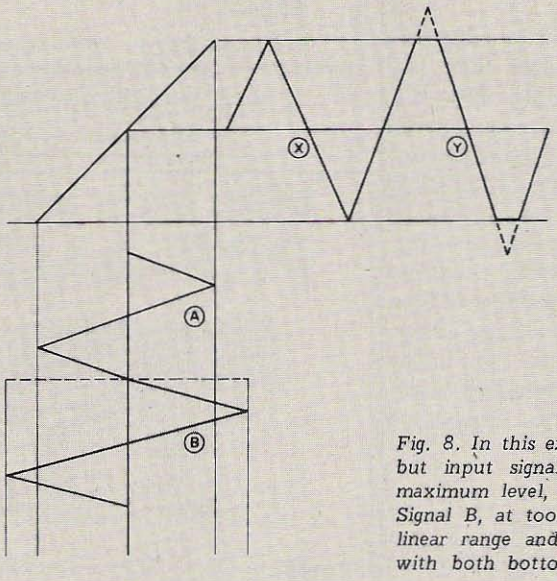

Fig. 8. In this example the bias is properly set but input signal is excessive. Signal A is at maximum level, and produces linear output X. Signal B, at too high a level, runs outside the linear range and produces distorted output Y with both bottoming and flat-topping evident.

Too much input signal, on the other hand, produces all sorts of ill effects, and you can find horrible examples all over any of the bands.

When input signal level in a class A amplifier is too high, either or both of two problems arise (Fig. 8). The positive-going peaks of the input signal completely overcome the amplifier's operating bias, which permits grid current to flow. If the designer has intended grid current, and allowed for it, this is not in itself bad – but most class A amplifiers are not meant to be used this way, and so grid current in 99 out of 100 of them indicates excessive input signal.

An oscilloscope will show you which of these two problems is present in an amplifier. If the positive peaks are causing the problem, the voltage waveform of the output signal will tend to be flattened off at its *negative* peak; if it's the negative peak of the input signal doing the dirty work, the output signal will be flattened at its positive peak.

In either case, the cure is simple: reduce the level of the input signal. The normal control for doing so is the audio gain control on the transmitter panel, or the volume control on the receiver. If your transmitter has no audio gain control (and

many do not) you can either speak a little more softly, or connect an attenuator pad (a sort of resistive voltage divider) between the microphone and the amplifier.

What about the output conditions? In our class A amplifier, which is normally used to provide voltage gain, this isn't usually adjustable. If it were, taking too little power out would tend to produce the same symptoms as putting in too much input signal, while attempting to get out too much power would show up as heating of all the amplifier components in addition to distortion.

Now let's see what happens when we misuse a class C rf power amplifier. For openers this time, we'll assume that it's the final output stage of a CW transmitter.

In many class C amplifiers using "fixed" bias, the bias level can be adjusted by the operator. Too low a bias level will result in low power output, and too high a bias level will generate excessive harmonic output. Most class C circuits these days, however, use a "self bias" arrangement in which the operating grid bias is developed by the flow of grid current through a "grid leak" resistor; with these, both the bias level and the input signal are set by the same control, which may be called the "drive" adjustment, or the "driver tuning."

Input signal level is not as critical with a class C amplifier as it was with class A, because we are not so concerned with signal distortion. The main thing is to have enough, without overdriving the circuit, and the designer usually specifies a broad range of operating conditions.

In circuits using self-bias, loss of drive causes loss of bias as well, with resulting high current in the amplifier stage and damage to all components in the plate circuit. For this reason it's good practice to adjust the drive level (input signal) with the amplifier plate and screen voltages turned off. If input signal is too small (too little grid current), bias will be too low and power output will be low. If it's too large (excessive grid current) harmonics will be excessive and the final-stage grid may be damaged.

With a CW transmitter, it's best to start with the amount of drive signal the designer recommends. After drive is developed, plate voltage may be applied and the output adjustments made, and then drive may be reduced until power output drops by a barely perceptible amount, and advanced by some 15 to 20% from that point. This assures minimum drive while still providing rated output from the amplifier, and will probably result in an input signal level within the designer's intentions.

For an AM transmitter, this adjustment of drive and loading may not be adequate. A modulated amplifier requires enough drive to supply the modulation peaks as well as the carrier level, but we'll go into that later when we examine the modulation process.

Output signal level adjustment in a class C amplifier is the most critical adjustment of them all. It should not be attempted until the input signal level has been brought into the correct range, because the tube or transistor may be destroyed in the absence of input signal.

Most transmitters have two adjustments for output tuning, one marked "tuning" and the other marked "loading." The normal practice is to set the loading control for minimum output, then rapidly adjust the tuning control until plate current dips sharply. This dip indicates that the output tank circuit is tuned to resonance, and is acting as a high impedance.

While this is all right for tuneup, which normally is done rapidly, it can damage the equipment if extended operation is attempted with too-little power being taken out. Whether you use it or not, a 500W amplifier is developing its 500W worth of current and voltage swing, and if you take only 50 of them out, the rest are going to be looking for mischief inside the amplifier. Tuning coils may overheat and melt their plastic supports, or capacitors may arc over.

To take more power out, the loading control is adjusted to increase plate current, meanwhile readjusting the tuning control to keep the dip at its minimum value. The readjustment is necessary because the two controls interact; increasing the loading reduces the "Q" of the tank

circuit, and changes the reactance at the same time. This process should be continued until the amplifier is producing its rated output, and then halted.

It's possible to load most class C amplifiers until the dip disappears, but if you check with an indicating wattmeter you'll find that pretty shortly after rated power output is reached, the output power begins to fall off even though the indicated input power keeps climbing. The extra power simply goes into the amplifier to be dissipated as heat, and can damage all the components.

Notice that while "distortion" was the key result when a class A amplifier was misued, "equipment damage" is the key result in class C operation. The tipoff to problems in class C is excessive plate current. If excessive plate current can be controlled by the tuning and loading controls, it probably indicates an attempt to get too much power out of the rig. If not, it probably indicates loss of operating bias, which can be due to loss of input signal.

Of course, a badly designed rig can draw too much plate current for other reasons. If the amplifier is subject to oscillation, either self-oscillation near the operating frequency or parasitics at far removed spots in the spectrum, this can cause excessive current. Similarly, component failure which removes the input signal can cause it. But the most common cause is simply trying to get something for nothing.

How about the "linear" used with an SSB transmitter? These rigs have a reputation for being tricky, but actually they're little if any more complex than a class C rig. The major difference, in fact, is that their designers set them up to operate in class AB, and to produce as little distortion as possible between input and output.

Since the bias level is the major factor controlling which class a specific amplifier is operating in, the bias of a "linear" amplifier must be set to the level specified by the designer. Most such amplifiers have a bias control accessible to the operator, which is intended to be adjusted for some specified value of plate current with no input signal applied. If bias is too low (too much plate current), the power capabilities of the amplifier will be reduced, and if it is too high, distortion will increase.

The input signal, also, is critical – but only at the upper end of the range. Linears are designed to accept input signals down to zero, but the maximum input signal level must not be exceeded if operation is to remain linear. Too much input signal (overdrive) causes distortion just as it does in a class A amplifier, with flattened peaks. In an rf amplifier, this distortion shows up as illegal harmonics outside the ham bands, as well as "splatter" and "buckshot" which may be within the bands but is not within the channel you are using. Such spurious signals are prohibited by FCC rules. The distortion produced by overdriving a linear amplifier is sometimes called "flat-topping" the signal, but overdrive is not the only cause of flat-topped signals.

Misadjustment of the output level can also cause flat-topping and other distortion problems. A linear amplifier is more critical in its output adjustments than in any other. In order to develop rated power output, the active device (tube or transistor) must work into its rated load impedance, and this impedance is set by the output tuning and loading controls.

If the adjustments are set for too little loading (less than rated output power), the load impedance will be too high and distortion will be produced. Similarly, if the amplifier is too heavily loaded, distortion will also result. Too heavy loading produces less distortion than too light loading, however, so in case of doubt it's best to err on the side of too much loading. This should not be confused with too much output – overdriving in an attempt to get more than rated power out is a sure way to generate a bad signal.

The distortion produced by underloading shows up as "peak clipping" which is a form of flat-topping. That resulting from overloading is "intermodulation" which can put the unwanted sideband back into the signal. To guard against such problems, most operators tune up linear amplifiers with the aid of an oscilloscope, which can show them the proper combination of all input and output level adjustments. ...Staff■

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Phone Patch Level Adjustments and Manproofing

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The procedure for adjusting your patch injection level is relatively simple, and may be done to a practical degree of accuracy with any ac voltmeter which can read as low as 1.5V full scale.

First, you should understand that there are two line wires and a floating ground in most phone systems. You are only interested in the line wires, and these are generally coded green and red. In any case you can find these two with a voltmeter, since there is a residual dc voltage on the line.

To calibrate your ac voltmeter to your phone's reference level, connect a 0.1 μF capacitor in series with one lead, to block the dc but pass the ac. If your multimeter has an OUTPUT setting, use that since such a capacitor is inserted internally. Use your lowest ac scale. Then take the phone off the hook and dial the first 3 digits of your own phone number. This will drop the dial tone and give you a clear audio line. Talk into the phone in a loud voice – a little louder than you talk on the phone normally. You will see the meter needle kick up to about 0.5V. Notice where it kicks up to as you talk, and then hang up the phone. You have now established your reference point.

To adjust the patch level, tune your receiver to a good QRM-free signal on the band, choosing one that causes your S-meter to at least show some value larger than S2 or so. Again dial the first 3 digits of your number, and flip the patch into the line. Adjust the receiver audio gain until the ac voltmeter on the phone line kicks up about the same as it did when you calibrated it with your own voice.

When completed, mark the audio gain now at the setting you found proper for your patch. This will be the correct level for all patch use, regardless of signal S value, because any decent SSB rig holds the audio output level sufficiently accurately, through it's normal agc action, to suffice for phone patching use. If you want more precision, however, you can leave some form of capacitor-isolated meter on the patch, as a sort of VU meter.

Do not omit the capacitor, and preferably use one in each lead to prevent shorting the phone line if you have an accident with the leads.

Manproofing the Patch

If you want to make your patch foolproof, you can do this to the extent that nothing you do on your patch will cause your phone to be out of service, nor prevent its use in a normal manner. To do this, do not connect your attachment wires

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directly to the phone wires. Instead, put a small electrolytic capacitor in both leads, right at the attachment point. The capacitance of these should be 2 or 4 μF each, and polarize them right so they block the dc on the line. This is done by finding out which phone wire is positive, and connecting the positive lead of one of the electrolytics to this phone wire, and connect the negative end of the other capacitor to the other phone line. Now, connect the two patch wires to the two dangling ends of the electrolytic capacitors. You can now short the patch, leave it on, etc, and you will not load the phone enough to cause more than a small decrease in its loudness.

A 2 μF capacitor is about the best value, since this causes an effective 1 μF total series capacitance in the patch line, which causes a 3 dB cutoff frequency of 300 Hz on the 900Ω line. This is an optimum match to an SSB receiver. If you decide to use these manproofing capacitors, install them before you calibrate the audio gain for patch injection, for better accuracy.

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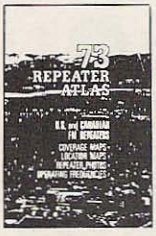

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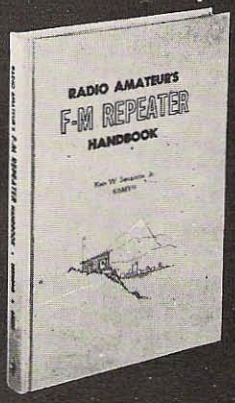

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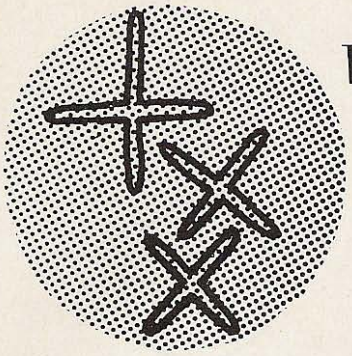

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Richard Tashner WB2TCC
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You will need three basics: a teleprinter with keyboard, a terminal unit, and a simple frequency shift keyer on your transmitter vfo.

A basic teleprinter like the Teletype Model 15 will cost about $75. This is where most of your investment will be. This unit will, with the addition of the terminal unit and frequency shift keyer, enable you to transmit and copy RTTY. A block diagram of a basic RTTY station is shown in Fig. 1. Note that the terminal unit (sometimes referred to variously as a TU, converter, or demodulator) hooks between the teleprinter and the audio output of your speaker.

The purpose of the demodulator is as follows:

The receiver picks up two alternating tones, one relatively high pitched and the other a little lower. The lower tone is called mark and the other, space.

Different combinations of mark and space tones correspond to specific letters, numbers, and punctuation marks.

The TU has a 150V, 60 mA "loop current" passing through it and the two electromagnets in the teleprinter known as selector magnets. As alternating tones come through the receiver the TU causes the loop current to go on and off in a definite pattern corresponding to each letter received. As the loop current is broken up, the machine prints the message.

On wide-shift systems, the frequency of the mark tone is 2125 Hz and the frequency of the space tone is 2975 Hz. With narrow-shift, the mark is 2125 Hz but the space signal is 2295 Hz (a difference of only 170 cycles).

To get these tones you put on your product detector as if for CW and tune in the RTTY signal for the correct tone frequencies with the aid of an oscilloscope. When the pattern on your scope is as shown in Fig. 2 the signal is tuned in correctly. Figure 3 shows tuning too low and Fig. 4 shows tuning too high.

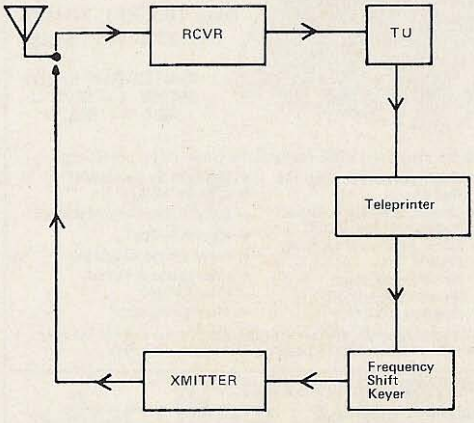


Fig. 1. Block diagram of RTTY station.

Transmitting RTTY

For transmitting, the keyboard is hooked up to the FSK circuit in your transmitter vfo. When a key is pressed the FSK circuit keys the vfo up and down in frequency with a definite pattern corresponding to the letter on the keyboard. There are many ways of doing this.

One way is to put the keyboard in series with the selector magnets. Then when a key is pressed the loop current is broken up the same way as when the TU breaks up the circuit on receiving. The loop supply in turn keys the FSK circuit.

Auto-Start

Some hams who have a net frequency (mostly on VHF) use a method called Auto-Start, which can prove quite handy. Suppose one person wants to send his friend a message, and both are on a net frequency. The friend leaves his receiver and terminal unit on 24 hours a day. The person who wants to send the message sends a five-second, steady mark (2125 Hz) signal. The receiver on the other end picks this up and the terminal unit which has a special Auto-Start circuit in it automatically turns on the motor in the teleprinter. The sending station then sends the message. At the end of the message he sends a steady five-second space signal (2975 Hz) to shut off the other station's teleprinter motor. The sending station then turns off his carrier. When the man returns from a hard day at work he goes up to his shack and reads what his friend has sent him during the day. He can reply in the same manner.

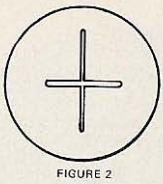


FIGURE 2

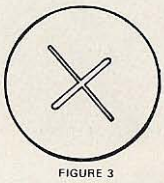


FIGURE 3

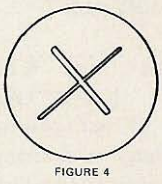


FIGURE 4

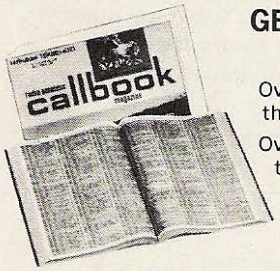
Figs. 2, 3, 4. RTTY scope patterns.

Where to Get More Information

I suggest, for those interested in getting more info on RTTY that they refer to handbooks by 73 and CQ magazines. They would also do well to get a copy of the RTTY Journal. It is put out by 'Dusty' Dunn W8CQ, PO Box 837, Royal Oak, Michigan 48068. Subscription rate is $3 a year.

. . . WB2TCC ■

radio amateur callbook



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PERF-BOARD TERMINAL

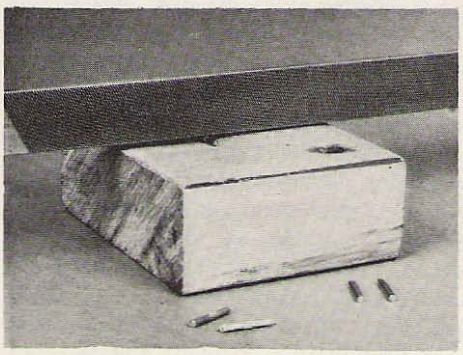
Having successfully used the type of Vector board with 3/32 in. perforations and the relatively large T9.4 terminals in several projects, I decided to try the type with 1/16 in. perforations and the small T28 terminals for more compact circuitry when recently building a frequency counter. The counter consisted mainly of integrated circuits and a great deal of interconnecting wiring, with up to four or five wires plus the IC being connected to a single terminal. The T28 terminals didn't seem to be very well suited to my purpose, so after some experimenting I came up with this substitute. It is a simple pin-type terminal that is inexpensive, easy to make and use, and better suited for some purposes than the T28 terminals.

Making the terminals

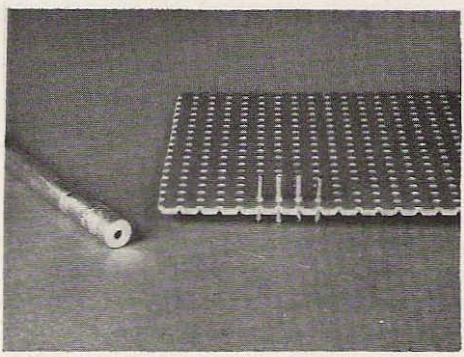
The terminals are made of 14-gage bare or tinned copper wire. Insulated wire is available at any hardware store, the least expensive being type TW. The plastic insulation is easily peeled off with a pocket knife. Clean the wire with fine sandpaper if it is tarnished or dirty.

Cut the wire to the length desired for the terminals. I found that a ½ in. length worked well for me. To easily cut a large number of terminals to exactly the same length, simply drill a 5/64 in. (diameter) hole in any convenient material to a depth equal to the desired terminal length. Then you merely insert the wire, clip it off flush, and allow the terminal to drop from the hole.

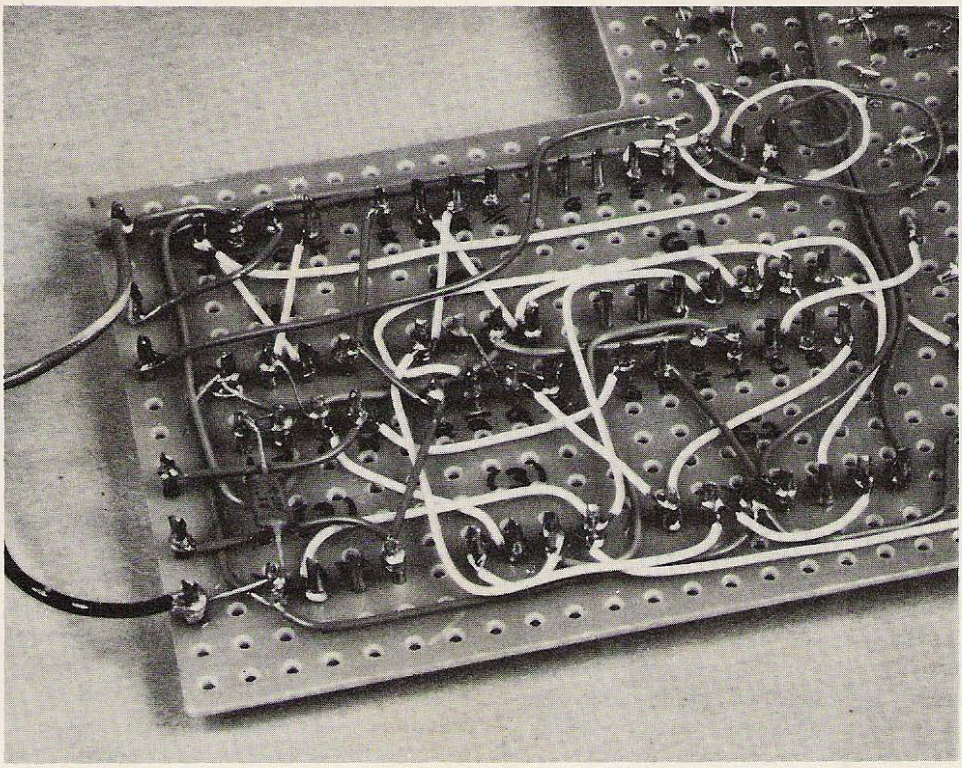
The 14-gage wire is a loose fit in the 1/16 in.-diameter board perforations, so it must be expanded slightly to make it a snug fit. This is done by knurling it lightly at the point where it will contact the board. Place the terminal on a small block of hard wood. Press down on the proper part of the terminal with the edge of a flat file. Move the file back and forth so as to roll the terminal beneath it. A few strokes



The terminals are knurled by rolling them under a file.



The terminals are easily inserted with a simple tool.



The wiring side of a board from the author's frequency counter, in which over 600 of the homemade terminals were used.

using moderate pressure will raise a series of ridges such as those found on the edge of a dime, and will make the terminal a tight fit in the board. I used an 8 in. file that had an edge width of 3/32 in., but any medium-cut flat file should work.

The terminals are easily inserted into the board with a simple tool. Take a piece of metal rod about 5 in. long and drill a 5/64 in. hole in one end to a depth equal to the length of terminal that will protrude from the board. Then place the terminal in the board, lower the tool onto the terminal, and press down firmly. Be sure to support the board near the terminal while doing this.

Advantages and disadvantages

The main advantages of using this terminal are that it will hold a large number of wires without difficulty, and you can wrap a wire around it and squeeze it tight with pliers without crushing the terminal. Also it is easy to make a good solid solder joint because of the large contact area between the wire and terminal. The removal of a wire is very easy, even if it is at the bottom of a stack of three or four. Just heat the joint and slide the wires straight up and off the smooth surface of the terminal. The wire ends will keep their shape and can be slid back on and resoldered.

The T28 terminals are better for holding small resistors and capacitors, and require less heat to solder than the homemade type. More care is necessary, however, to prevent cold solder joints if several wires are to go into one slot.

The homemade terminals are very inexpensive, costing about 12 cents per 100, but the time involved in making them probably nullifies any saving. In the frequency counter previously mentioned I used over 600 of the homemade terminals and about 40 of the T28 terminals, with each type doing its particular job very well.

. . .K5LLI■

TUNING ALL-BAND VERTICAL ANTENNAS

John G. Harder W5QKO/AI4QKO
6200 Air Base Wing
APO San Francisco 96274

A vertical actually makes a pretty good antenna, provided your match allows you to radiate the signal you put into it.

All-band vertical antennas are inexpensive space-savers which can do a surprisingly good job at their best, but often give disappointingly bad results. Newcomers are often attracted to these antennas by the cost savings over more complicated arrays, but many encounter considerable frustration in the attempt to make the unit perform as it is supposed to.

An example of this type of continuously tuned antenna is the WVG Mark II. It is basically a multisection aluminum whip in an insulated mounting which attaches to a short length of pipe for ground mounting or to a piece of TV mast for rooftop use with radials. The unit is supposedly designed to be fed with 52Ω coax. The coax shield connects to the ground rods or radials. The center rf conductor of the coax is normally tapped down on a loading coil to achieve resonance at the frequency in use, while simultaneously providing a satisfactory impedance match to the coaxial line. On 20 and above, the whip alone is usually used with direct coax feed.

Practically speaking, this procedure seldom produces a match which permits anything like a truly efficient transfer of power from the feedline to the antenna. It doesn't take much knowledge of antenna theory to understand that if the power doesn't get into the antenna, it doesn't get radiated. On some bands the coil and whip may show resonance at the desired frequency when checked with a grid dip meter, only to prove unusable because the impedances are still mismatched.

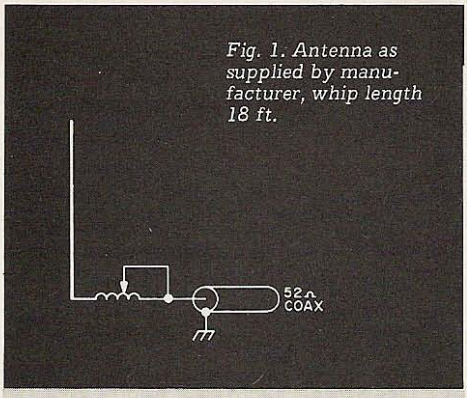


Fig. 1. Antenna as supplied by manufacturer, whip length 18 ft.

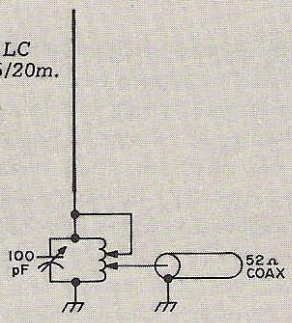


Fig. 2. Parallel LC network for 15/20m.

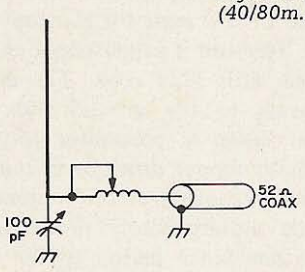


Fig. 3. L network (40/80m.)

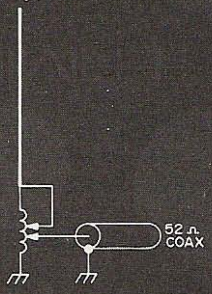


Fig. 4. Tapped coil only; usable on some frequencies.

While some equipment *will* load into a line with a vswr of greater than 2:1, most manufacturers these days specify low vswr to avoid such conditions as overheating of TV sweep-tube finals and radiation of rf from the transmitter cage. The answer for some is to give up and try a more expensive antenna, such as a trap vertical. But before spending those dollars, why not try to do a better job of matching than the coil can do alone? This can be achieved by simply adding a small variable capacitance at the feedpoint, using clip leads to allow it to function as part of an LC network in series or in parallel. Using an additional tap on the coil will allow the 52Ω feed to be matched more accurately.

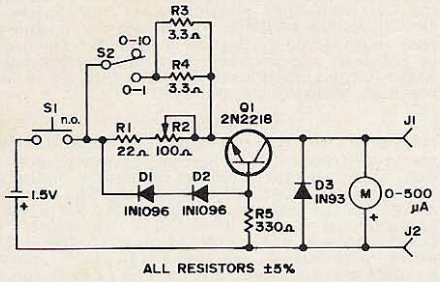
The exact amount of L and C needed for resonating and matching at a given frequency will depend mainly on the type of mounting and ground system in use. Before trying the matching network idea, I found that a vswr of 2:1 was the best obtainable on several bands. On 15 meters, the antenna was completely unusable with a vswr over 3:1. It was of course possible to adjust the whip length for 15m, but band-changing became a major chore.

After use of the matching network, the results were very satisfying. It was possible to reach less than 1.3:1 on all bands, and I found that by proper placement of the coil taps I could go from 15 to 20m with just a twist of C alone. This convenience was well worth the effort.

After matching with a standing-wave bridge connected at the feedpoint, all I had to do was mark the coil taps and positions of C, and band-changing was now possible in a matter of seconds. Besides all this, my first QSO after the job was done resulted in a good report from UAØKFG with only 150W input at my end!

Possible refinements include mounting of the whole network in a waterproof container such as a refrigerator box or plastic 3 x 5 card file that includes its own hinged lid. By careful choice of methods shown for setting up the network, your antenna will now work efficiently on any band from 80 through 10m and on MARS frequencies in between.

...W5QKO/AI4QKO■



The Low-Ohm Meter

A. Schecner W3YZC
122 Sherry Lane Apts.
Conshohocken, PA 19428

Did you ever try to get a good resistance reading on a speaker voice coil? Or an automobile ignition ballast resistor? Or a pilot light bulb, length of coax, relay contact, loading coil, identifying transformer windings, centertaps, etc.? If you have, then you've found that most ohmmeters don't have a really low resistance scale – or if they do the zero setting is unreliable and the meter scale inadequate. After years of annoyance from this problem I finally decided that a low-value ohmmeter would be a handy device to have around. In fact, applications for this meter just seem to suggest themselves. Why bother building a new version of an old instrument and not incorporate new innovations? So I came up with these requirements:

- No zeroing knob – just a "set it and forget it" calibration control.
- Linear scale reading from zero to a fixed value, rather than to infinity. What good is infinity to an ohmmeter, besides making the upper 25% or so of the scale relatively useless?
- Solid terminal connectors rather than wires with probes (optional). This would prevent poor contacts in the circuit, leading to error.

The finished version uses one size D flashlight cell, has two scales – zero to 10Ω, and zero to 1Ω. A "test" switch (momentary pushbutton) is used because of the high current requirement of the circuit. Battery life is conserved in this way.

Theory of operation

The circuit consists of a constant-current generator (Q1) to provide a known current through the test resistance. The voltage drop across this resistance (100 mV maximum) is read on a meter whose internal resistance is much higher than a test resistance of 10Ω. Therefore, the meter does not load the circuit.

A bias for Q1 is established by diodes D1 and D2 and resistors R1, R2, R3, R4, and R5. Use of the diodes holds the bias level constant despite nominal decay of battery voltage. Diode D3 prevents severe overload of the meter in the absence of a test resistance. In case the test button is pressed, the meter will overload, but not much, thanks to D3.

My meter was obtained when I scrapped a Heath grid-dipper after buying a solid-state model. The meter requirements are 500 μA full scale, 200Ω resistance. A substitute may be constructed by using a more sensitive meter with a shunt, so long as the result is 500 μA, 200Ω.

Construction

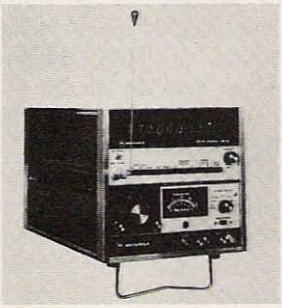
Layout is not critical, but solder connections *must* be solid and medium bus wire must be used. The battery connector must make tight connection with the battery. Check internal resistance by shorting the test terminals with heavy wire. Pressing the test button should give a reading of zero.

Transistor Q1 may be replaced by any one of a number of high-beta NPN types. Try what you have around and see if it works. R2 may be used to balance slight differences if another transistor is used. Calibrate by testing a precision 10Ω resistor (0–10Ω scale) and setting the calibration control for a full-scale reading. The other scale should follow automatically.

NEW PRODUCTS

Digital Frequency Meter

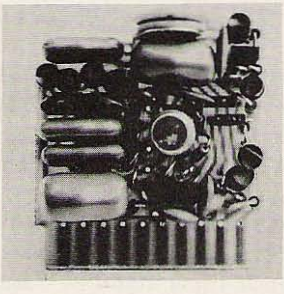
Motorola has introduced a new digital frequency meter, the S-1325A, with 50 mV sensitivity and eight-digit readout. The unit provides continuous frequency coverage from 50 Hz to 525 MHz in two ranges. The resolution and oscillator stability far exceed FCC requirements of two-way radios, making the unit truly obsolescence proof. The advanced modular integrated circuit design assures simple, reliable operation and ease of maintenance. A built-in deviation meter provides



total servicing capability for frequency and FM deviation measurements. For complete technical specifications, write *Motorola Communications and Electronics, Inc., 1301 East Algonquin Road, Schaumburg IL 60172.*

Silent Sentry (SS-80H)

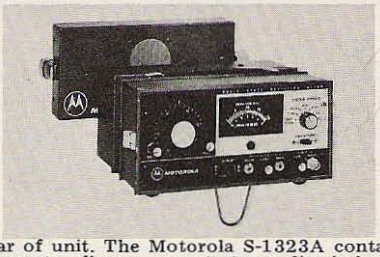
Because of increased demand for a reliable solid-state subaudible continuous tone encoder/decoder that is small enough to fit internally in portable and hand-held two-way radios as well as some of the very small mobile and base station models, Alpha Electronic Services has developed the SS-80H. Measuring only 1-1/2 x 1-1/4 x 1/2 in., it is believed that this is the smallest unit of its kind. The SS-80H meets or exceeds EIA specifications, and coupled with the frequency determining module (TN-91H), can be installed internally in equipment where space is a severe problem. Completely compatible with Private Line, Channel Guard, or other standard frequency tone quieting devices, the SS-80H also is available on special tone frequencies, allowing greater use of congested channels. Utilizing solid-state circuitry, this reliable accessory makes



possible more efficient use of two-way radio communications by relieving the user from listening to cochannel chatter. Easy installation instructions are available for all two-way radios and free engineering assistance is provided for unique or difficult applications. For information call or write *IAlpha Electronic Services Inc., 8431 Monroe Ave., Stanton CA 90680.*

Deviation Meter

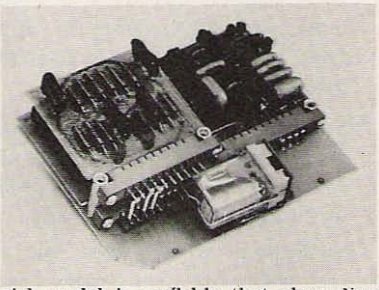
Motorola's S-132A portable solid-state deviation meter provides direct reading measurements for fast, accurate servicing of two-way radio and other communications equipment. The advanced design of the instrument eliminates the need for complicated setup procedures. Complete and self-contained with built-in local oscillator; no other accessories are required. Two carrying handles are provided, one on top of unit and one



on rear of unit. The Motorola S-1323A contains an accurate, linear, countertype discriminator and a heavily degenerative peak-to-peak voltmeter. A highly stable conversion oscillator provides accurate measurement to 1000 MHz with low inherent residual modulation and maximum freedom from drift. An IC audio amplifier drives a speaker built into the front cover of the unit permitting off-the-air monitoring. For complete technical specifications write *Motorola Communications & Electronics, Inc., 1301 East Algonquin Road, Schaumburg IL 60172.*

Dual-Frequency Subaudible Tone

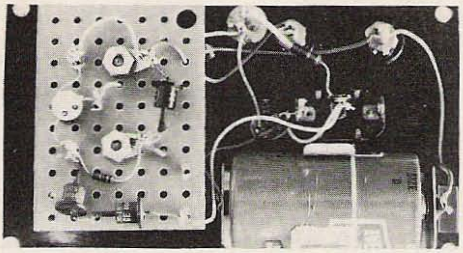
The Alpha DTSS-80 two-frequency transistorized subaudible continuous tone squelch system is exceptionally useful where there exists a need to have a choice of tone frequencies for the purpose of controlling or selecting repeater stations, base stations, or mobile radio units. By a simple two-position switch the dual tone makes possible the employment of multiple repeaters increasing the range capabilities of a radio communications system. The selective calling of two base stations, two groups of mobiles, or special control functions are other uses that this versatile device can accomplish. Each DTSS-80 tone unit is comprised of a plug-in encoder/decoder board and two plug-in TN-91 frequency determining boards.



A special model is available that plugs directly into GE's MASTR mobile radio units. For information call or write *Alpha Electronic Services Inc., 8432 Monroe Ave., Stanton CA 90680.*

Two Capacity in CK06 Style

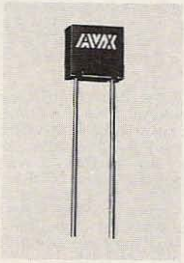
Capacitance values up to 2 μF can be obtained in the newest model Ceraseal ceramic capacitors. The new units incorporate the high capacities in a modified CK06 case style with a thickness of only 0.150 in. Previous capacitance values had extended only up to 1 μF. In the



Photos 1 and 2 show the meter built in a Bakelite box with aluminum panel. I have measured the resistance of a loading coil of a new Hustler mobile antenna and compared it to my old beat-up one. I planned to build a dipole out of the two of them and wanted to be sure everything was okay. Resistance of the probes I used was 0.2Ω, by shorting them together, the total reading (probes + coil) was 1.0Ω. Therefore the coils were 0.8Ω.

Other uses will suggest themselves. I hope you will find this novel instrument as useful as I have.

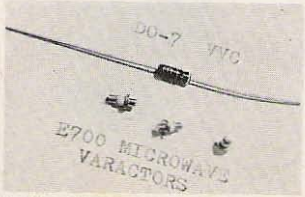
. . .W3YCZ



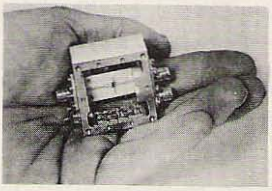
Ceraseal series, a ceramic case encloses the unit's active layers. A thin epoxy coating is applied to the finished unit for additional protection. Use of the ceramic case, which is formed as an integral part of the capacitor before firing, results in the production of a truly solid-state capacitor featuring monolithic construction combined with complete hermeticity for use in aerospace, computer, and military applications. *Aerovox Corp., New Bedford MA 02741.*

Amateur Radio Varactors

A new family of high Q varactors for amateur radio service in application from i-f's up through 450 MHz. These varactors now make practical very compact equipment by replacing mechanical tuning with electronic tuning. Amateur uses include AFC, incremental tuning of transceivers, remote control, and simplified frequency modulation. Application notes and data sheets are available from the manufacturer. Prices range from $1.50 to $6.50 in small quantities. *Eastron Corp., 25 Locust St., Haverhill MA 01830*



Double-balanced MIC Mixers



A new series of double-balanced MIC (microwave integrated circuit) mixers combines low-noise performance and wide bandwidth. The mixer-preamplifier (illustrated) provides multi-octave bandwidths, low IM distortion, and beam-lead Schottky diodes. Available with hybrid IC preamplifiers as well as discrete component units. *RHG Electronics Laboratory, Inc., 94 Milbar Blvd., Farmingdale NY 11735.s,*

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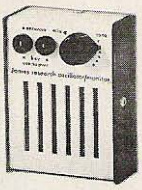
mark2
oscillator/monitor



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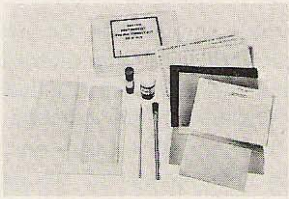
Direct Positive Photoresist Kit

Vector Electronic Co. Inc., 12460 Gladstone Ave., Sylmar, Calif. has just announced the availability of two new etched circuit kits. According to the manufacturer, these kits are different than other kits now available because they make use of easy-to-make positive artwork, much of which is preprinted and in the kits, plus photo- sensitized copper-clad boards in various sizes. With the materials supplied (which includes everything except water and a photoflood bulb) the user can make sharply defined etched circuits in single or multiple quantities quickly and inexpensively in the laboratory or school without photography. Lead layouts for integrated circuits, transistors, and connector patterns are all ready for transfer to the master circuit mylar



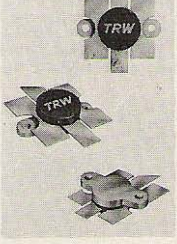
sheet provided. The photo-sensitized copper clad board, which can be used without a darkroom is then exposed to an ultraviolet light source, a photoflood lamp, or bright sunlight to produce a copy of the Mylar circuit image. This image is quickly developed with the chemical provided. The board can then be etched in the furnished etchant that comes in a durable plastic bag which may be shaken inside a plastic box (also furnished) without leakage. Because of the agitated etching, sharply defined circuits can be produced. If a number of the same circuit boards are required, duplicates can be made quickly using the same Mylar master. Kits sell for from $8.95 for the 32X sampler assortment to $24.95 for the professional sized version model 32XA. Kits may be ordered now from the manufacturer, or purchased from the firm's distributors. *Vector Electronic Co., Inc., 12460 Gladstone Ave., Sylmar CA 91342.*

Groundplane Antenna

Varitronics introduces the *Redhead*, a two meter 3.4 dB gain groundplane antenna. This sturdily built, commercial-quality unit is adjustable for low vswr ofer the entire 2 meter band. Both radials and radiator are built of heavy gage aluminum conduit, and the loading coil is well protected by a metal shield which is painted red. The antenna is rated at 500 SSB, 250W CW, AM, FM. See the Varitronics AS-2HG *(Redhead)* at your dealers. Only $18.95.

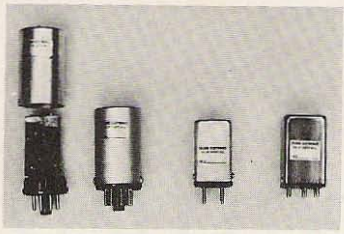
Octave Bandwidth of New 40W on 220-400 MHz

TRW Semiconductor announces a new UHF power transistor offering a state-of-the-art combination of bandwidth, power, and frequency. The family of transistors is termed "J-Zero," because internal matching circuitry reduces input reactance to essentially zero. The new hybrid transistors provide high input resistance with lower input Q. Simple input circuitry with minimum tuning allows combining for output



powers of over 100W across the band. High volume production thus becomes practical for the first time in high-power broadband UHF equipment. Characteristics of TRW type J0-2001 are as follows: 40 watts rf power output from a 24V source; 5 dB gain across 225—400 MHz band; minimum efficiency of 50%. Technical details are available from *TRW Semiconductor Div.,14520 Aviation Blvd., Lawndale CA 90260.*

Series of Highly Stable Oscillators Developed for Two-Way Radio Equipment

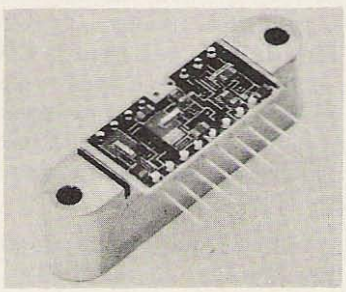


A new line of temperature-compensated oscillators that provide a direct replacement for most crystal ovens used in two-way radio communication equipment was announced by Michael Sigmon, Product Marketing Manager of Sentry Manufacturing Company.

1970 Catalog of ICs and Semiconductors

A complete line of integrated circuits and semiconductors for hybrid microelectronic fabricators is now available from Starnetics. These include the related advanced products of a number of manufacturers. Semi-conductor devices, digital and analog integrated circuits, and memory networks are covered in the offering. All products are stocked in depth and are tested and certified to current military specifications as appropriate. The catalog describing these new products is free and can be obtained by writing *Starnetics, 10639 Riverside Dr., North Hollywood CA 91602.*

Broadband RF Microcircuit



TRW Semiconductors has introduced a new broadband rf microcircuit amplifier, CA800. The amplifier has 5—500 MHz bandwidth with 25 dB gain across the band. It is a universal broadband-gain block in thin-film hybrid IC form for use in 50Ω instrumentation and radio systems. With a 28V supply, 400 mW of CW power output is achieved. *TRW Semiconductor Div., 14520 Aviation Blvd., Lawndale CA 90260.*

Antennas

Cush Craft has just released its new amateur antenna catalog. It includes photographs and complete specifications of more than 50 popular amateur antennas and accessories. To receive your free copy of the catalog write to Cush Craft, 621 Hayward St., Manchester NH 03103.

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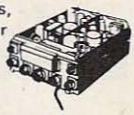

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Trying to insure contacts with Gus (W4BPD) as he roamed the Indian Ocean this past summer (1970), I found a feature lacking in my nearly new SB-301 and SB-401 combo – namely, the inability to use either master oscillator in the receive mode. Only by using a separate receiver could I keep my SB-401 transmitter somewhere in Gus' rather widespread listening area and have a chance of a contact. Two receivers add to the station cost and complexity and often make difficulties for the operator, especially during those late night sessions.

An excellent article by John H. Lehman (WA8MHO) in the January 1970 QST shows how to modify the combo to achieve instant selection of two transceiver frequencies, but this involves rework of the panels which many find abhorrent and provides a function which I didn't need (switching the transceiver frequencies). Also, with only one master oscillator controlling the transmit frequency (that in the SB-401) there would be less chance of operator error.

After studying the problem, it was determined that the switch could be replaced by relays to achieve the same results. However, since we only wanted to switch the tuning arrangement for receiving, one relay in the SB-301 could perform the necessary function.

The circuit shown in Fig. 1 was built using mainly junkbox parts, helped out by finding a suitable 117V ac relay so that no tapping off receiver power was necessary. Keep the coax leads from the relay to the plug and socket in the SB-301 as short as possible to reduce the drive lost in the transceiver position. By proper measurement, it can be built outside the combo and then merely plugged in, letting the one coax cable which runs from the SB-301 to the SB-401 lay under the lids where it is hardly noticeable. However, if one can take the time from operating and DXing to remove the units from their cases, holes can be drilled to permit a straight-through cable run. Use coax cable which is the same as or compatible with that provided in the combo.

A Y-phono connector is plugged into the output socket of the SB-401 master oscillator. The original SB-401 lead plugs into one arm of the Y, the relay lead into the other. Although this adds several inches of coax to the transmitter oscillator output circuit, no loss in drive was detected during operation.

Operation

The SB-401 must be placed in the unlocked position as for any split frequency operation.

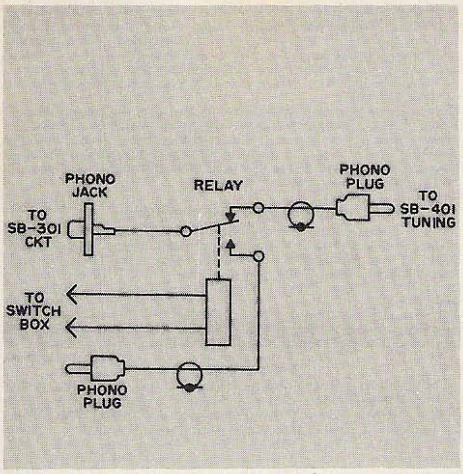

Fig. 1. Schematic of simple modification. Phono plug and socket in the SB-301 mate with existing socket and plug. Phono plug in the SB-401 mates with one arm of Y phono connector. Relay position shown is unenergized and receiver master oscillator is controlling frequency.

Then activating the switch to energize the relay coil (I used a two-position single-pole switch with one side a momentary-on), you can tune in the signals of those who are calling and working Gus; release the switch and you are hearing Gus.

Depending upon components used, coax lengths and previous condition of the combo, there can be some changes in drive during transceive, and an extremely strong signal may feed through faintly during receive but these are considered a minor price to pay in view of the gain in ease of operation during our Gus watching (and working) periods.

All of this for under $8, if you procured everything. A good junkbox would make it free. I bought a small minibox and switch for $2 and installed a neon indicator in the box. The box rests near the SB-301 tuning knob where it is convenient for my left hand to operate as I take a quick listen for my competitors when Gus is listening.

Although this modification may not satisfy the purist, it brings results; I snagged KP6AL and VS5RG (on two bands) during its first week in operation. I hope it proves of assistance to others using this fine combo.

...W9SDK■

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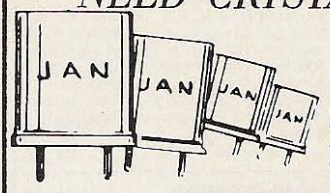

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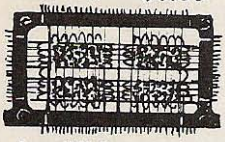

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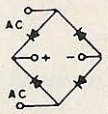


PIV	Sale
☐ 50	$1.19
☐ 100	1.39
☐ 200	1.59
☐ 400	1.85
☐ 600	2.15
☐ 800	2.50
☐ 1000	2.95

GIANT SALE ON NEW TTL TEXAS & NATIONAL ICs

Guaranteed! W/Spec Sheets
Any 3 — 10% Discount!

Type	Description	SALE
☐ SN7400N	Quad 2 Input Nand Gate	$ .88
☐ SN7402N	Quad 2 Input NOR Gate	.88
☐ SN7404N	Hex Inverter	.99
☐ SN7410N	Triple 3 In. NAND Gate	.88
☐ SN7420N	Dual 4 In. NAND Gate	.88
☐ SN7430N	8 Input NAND Gate	.88
☐ SN7440N	Dual 4 In. Nand BUFFER	.88
☐ SN7440F	Dual 4 In. Nand BUFFER	.88
☐ SN7441N	BCD to Decimal Driver	4.95
☐ SN7442N	BCD to Decimal Decoder	4.50
☐ SN7470F	J-K Flip Flop	.99
☐ SN7472N	J-K Master Slave Flip Flop	1.19
☐ SN7473N	Dual J-K Master Slave Flip-Flop	1.49
☐ SN7474N	Dual "D" Type Edge Triggered Flip Flop	1.49
☐ SN7475N	4 Bit Bistable Latch	2.95
☐ SN7476N	Dual J-K Master Slave Flip Flop	1.49
☐ SN7483N	4 Bit Binary Full Adder	4.50
☐ SN7490N	Decade Counter	3.98
☐ SN7492N	Divide-by-twelve Counter	4.50
☐ SN7493N	4 Bit Binary (divide by 16)	3.98
☐ SN7495N	4 Bit Right & Left Register	4.50

Code: F — Flat Pak, N — Dual Inline

"CELESTIAL LIGHTS" 3-LEVEL FIBER OPTIC DISPLAY KIT

- 1400 multi-colored fibers
- 18" high of brite lites
- Cordless light source
- Variable color control
- SAFE! FUN! EDUCATIONAL!

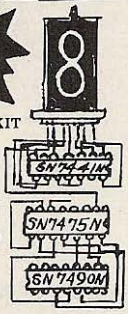
Kit: 1400 glass fibers 2-ft. long, accessories, adhesive, self-powered light source, "Blinky", booklets **$4.95**

SPRAGUE- IC's

Your Choice 3 for $1

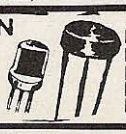
- ☐ 908 Full Adder
- ☐ 909 Buffer
- ☐ 912 Half Adder
- ☐ 913 Shift Register
- ☐ 960 Dual Buffer

COUNTING SYSTEM $11 3 PC. KIT



Includes SN7490 decade counter, SN7441 BCD decoder-driver, SN7475 quad latch with hookups, instructions.

EPOXY SILICON TRANSISTORS 5 for $1



Type	Sale
☐ 2N2222	5 for $1
☐ 2N3565	5 for $1
☐ 2N3638	5 for $1
☐ 2N3641-3	5 for $1
☐ 2N3645	5 for $1

NIXIE* TUBE $5.95

(0–9), wide angle
*Similar to Burroughs

FAIRCHILD'S POPULAR "IC" TWINS — RTL914 & RTL923

With Spec Sheets!

- ☐ 914/921 Dual 2 input gate .....
- ☐ 923/940 J-K flip flop .....

2 For $1

WINTER CATALOG ☐ 10¢

1971 BUYS BARGAIN CATALOG

POLY PAKS

P.O. BOX 942 A
Lynnfield, Mass.
01940

Terms: add postage. **Rated:** net 30, cod's 25%
Phone Orders: Wakefield, Mass. (617) 245-3829
Retail: 211 Albion, St., Wakefield, Mass.

73 Reader Service Coupon

Now we don't say that every single reader must buy every last product advertised in 73. We believe that, but we don't say it. The very least every reader can do is to put on a show of interest in the products herein advertised. To make this a simple task, even for the laziest reader (now there is a contest for you!), we have cleverly arranged the advertising index to double as a readers service coupon. All you have to do is tear it out (or photocopy it) and send it in with the appropriate boxes marked. (We have a prize for the most boxes marked . . . a silent prayer of thanks from the publisher). We'll accept postcards, slips of paper, or almost anything else that lists the companies you want to hear from and your address.

No one likes to go into a store without buying something, right? It is the same with these information requests. You will be expected to buy something. Oh, it doesn't have to be a $50,000 antenna system, but it should be something modest . . . a transceiver . . . a linear . . . you know. We'll leave the decision up to you, knowing that we can trust you to do the right thing.

And we are definitely not saying that the use of this service coupon has any curative powers, but we cannot notice that many readers report remarkable relief from simple backache, headaches, lumbago, and acid indigestion after sending in their coupon. Why take any chances?

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MAIL TO **73 Inc., Peterborough NH 03458**

Name_____

Call_____

Address_____

_____ Zip_____

PROPAGATION CHART
J. H. Nelson
Good O Fair (open) Poor☐

February 1971

SUN	MON	TUES	WED	THUR	FRI	SAT
	(1)	(2)	(3)	4	5	(6)
(7)	(8)	(9)	(10)	11	[12]	[13]
14	15	16	(17)	(18)	(19)	20
[21]	(22)	(23)	(24)	25	26	27
28						

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	7	7	7	7	14	21	21
ARGENTINA	14	7	7	7	7	7	14A	21	21	21	21A	21
AUSTRALIA	21	14	7B	7B	7	7	7	14B	14	14	21	21
CANAL ZONE	14	7	7	7	7	7	14	21	21	21	21	21
ENGLAND	7	7	7	7	3A	7B	14	21	21	14	7B	7
HAWAII	21	14	7B	7	7	7	7	7B	7A	21	21A	21
INDIA	7	7	7B	7B	7B	7B	14	14	7B	7B	7B	7
JAPAN	14	7B	7B	7	7	7	7	7	7B	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	21	21	21A	21
PHILIPPINES	14	7B	7B	7B	7B	7B	7	7	7B	7B	7B	7B
PUERTO RICO	14	7	7	7	7	3A	14	21	21	21	21	14
SOUTH AFRICA	14	7	7	7	7B	7A	21	21A	21A	21	21	14
U. S. S. R.	7	7	7	3A	7	7B	14	14	14	7B	7B	7
WEST COAST	21	14	7	7	7	7	7	14	21	21	21A	21

CENTRAL UNITED STATES TO:

ALASKA	21	14	7	7	7	7	7	7	7	14	21	21
ARGENTINA	14A	14	7	7	7	7	7	14A	21	21	21A	21
AUSTRALIA	21	14	7B	7B	7	7	7	7B	14	14	21	21
CANAL ZONE	21	14	7	7	7	7	7	14A	21	21	21A	21
ENGLAND	7	7	7	3A	3A	7	7B	14	21	14	7B	7
HAWAII	21	14	7B	7	7	7	7	7	7A	21	21A	21
INDIA	7	7	7B	7B	7B	7B	7B	7	7	7B	7B	7B
JAPAN	21	14	7B	7	7	7	7	7	7	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	7B	7B	7B	7B	7	7	7	7B	7B	14
PUERTO RICO	14	7	7	7	7	7	14	21	21	21	21	21
SOUTH AFRICA	14	7	7	7	7B	7B	14	21	21A	21	21	14
U. S. S. R.	7B	7	7	3A	7	7B	7B	14	14	7B	7B	7B

WESTERN UNITED STATES TO:

ALASKA	21	14	7	3	3	3	3	3	7	14	21	21
ARGENTINA	21	14	14	7	7	7	7	14	21	21	21	21
AUSTRALIA	21	21	14	7B	7	7	7	7	7	14	21	21
CANAL ZONE	21	14	7	7	7	7	7	14	21	21	21A	21
ENGLAND	7B	7	7	3A	3A	7	7	7B	14	14	7B	7B
HAWAII	21	21	14	7	7	7	7	7	7A	21	21A	21A
INDIA	7B	14	7B	7B	7B	7B	7B	7	7	7	7B	7B
JAPAN	21	14	7B	7	7	7	7	7	7	7	7B	14
MEXICO	21	14	7	7	7	7	7	7A	21	21	21A	21A
PHILIPPINES	21	14	7A	7B	7B	7	7	7	7	7B	7B	14
PUERTO RICO	14	7	7	7	7	7	7	14	21	21	21A	21
SOUTH AFRICA	14	7	7	7	7B	7B	7B	14	21	21	21	14
U. S. S. R.	7B	7	7	3A	7	7B	7B	7	7	7B	7B	7B
EAST COAST	21	14	7	7	7	7	7	14	21	21	21A	21

A = Next higher frequency may be useful also.
B = Difficult circuit this period.